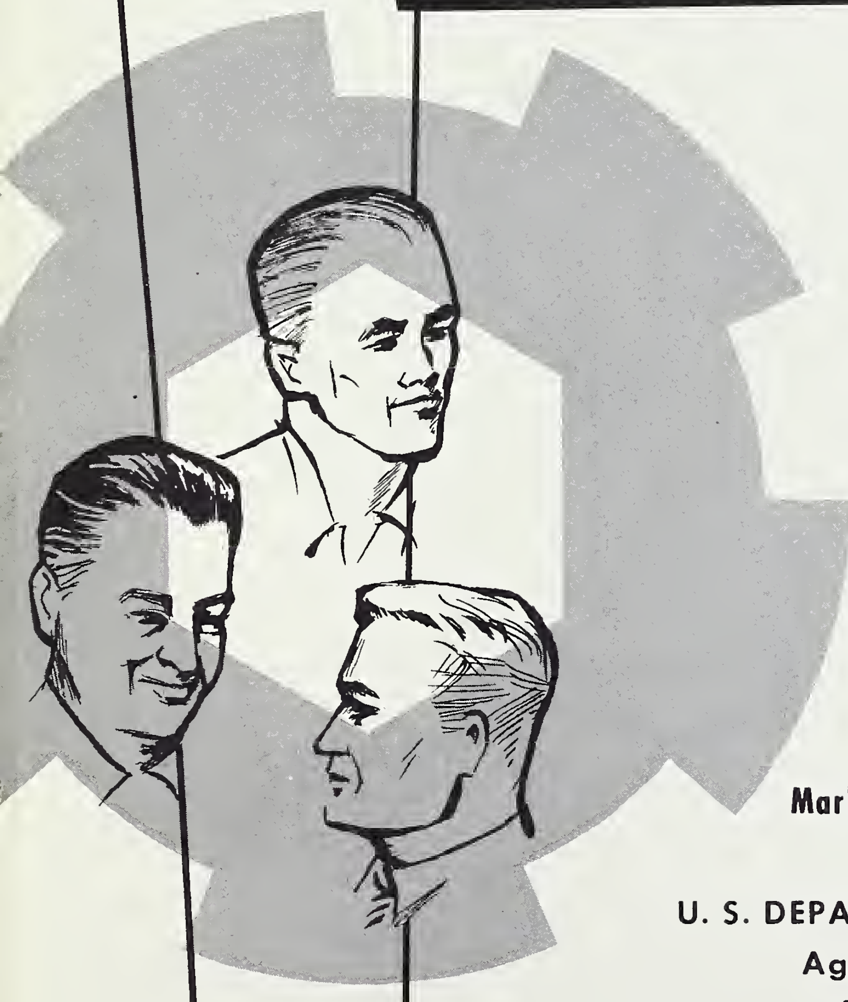
LABOR and POWER UTILIZATION

at Cottonseed Oil Mills



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John M. Brewster, agricultural economist, served as project leader in the study until October 1956, when he transferred from the Agricultural Marketing Service to the Agricultural Research Service. During the first part of the project, Mr. Brewster took the lead in developing the schedules used by the contractor and in supervising the contract. Later, he gave valuable suggestions and assistance in correlating the results with previous studies.

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The mill operators cooperated by making data available for the analysis.

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LABOR AND POWER UTILIZATION AT COTTONSEED OIL MILLS

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SUMMARY

Cottonseed oil mills of all types (hydraulic, screw-press, and solvent-extraction) can improve their utilization of labor, power, and steam considerably, and thereby lower unit processing costs. This is evidenced by the wide variation in the amount of labor, electric power, and fuel used by the 123 cottonseed oil mills surveyed. Costs of labor ranged from $1.29 to $8.14 per ton of seed, whereas cost of electric power and fuel ranged from $0.82 to $2.95 per ton.

The mills analyzed varied from 25 to almost 500 tons in daily processing capacity and had annual crushes ranging from less than 1,000 to more than 100,000 tons of seed. Because of the decrease in seed supplies in recent years and the excess crushing capacity in the industry, many mills are unable to operate continuously at their normal daily rate. In the 1954-55 season, about 25 percent of the mills surveyed crushed one-third less than in the previous season. Mills crushing 100 tons and under per day crushed 26 percent less in 1954-55 than in 1953-54, whereas mills of more than 100 tons crushed 11 percent less. Reductions in seed supplies, and the corresponding adjustments in operating schedules, made it much harder for mills to keep their unit processing costs as low as they usually do with larger quantities of seed.

For each type of mill, a pronounced relationship was found between size of mill and the amount of labor used per ton of seed on a typical operating day. Almost one-half of the variation in man-hours used per ton of seed was accounted for by size of mill. Labor decreased, on the average, from 5.8 man-hours per ton in hydraulic mills with a daily crushing capacity of 50 tons to 2.6 man-hours per ton in 250-ton mills. For screw-press mills ranging in size from 25 to 450 tons per day, labor decreased from 4.1 to 1.0 man-hours per ton, and for solvent-extraction mills of 160 to 475 tons per day, the decrease, on the average, was from 2.7 to 2.1 man-hours per ton.

If mills of a given type were similar in all respects except size, then the smaller the mill, the more man-hours it would normally use per ton of seed, but the less total man-hours it would normally use per day. Under actual conditions, however, many small mills used more total daily man-hours than the larger ones. For example, some screw-press mills processing under 100 tons per day used almost 450 total man-hours on a typical operating day, whereas other screw-press mills of 200 and 250 tons' daily capacity used less than 350 total man-hours. Similar examples applied also to hydraulic and solvent-extraction mills.

More than one-half of the mills operated on two 12-hour shifts per day, whereas about 40 percent worked on three 8-hour shifts, and 7 percent on one 12-hour shift. Although no difference in labor usage was associated with number of operating shifts, wages (straight-time hourly) paid by mills operating on 12-hour shifts were lower than those paid by mills on 8-hour shifts.

There was wide variation in power and steam usage among mills of the same type. About 25 percent of the mills used steam instead of electric power to run the mill. Small mills of all types used more power per ton of seed, on the average, than large mills. Screw-press mills averaged 135 kilowatt-hours per ton of seed, compared with 110 by hydraulic mills, and 105 by solvent-extraction mills. Power usage ranged from 100 to 190 kilowatt-hours per ton of seed for screw-press mills, from 80 to 150 for hydraulic mills, and from 80 to 120 for solvent mills. Electric power costs per kilowatt-hour consumed ranged from about 0.5 to 2.1 cents for electric-powered mills and from 0.9 to 3.3 cents for steam-powered mills.

Solvent-extraction mills averaged 1,200 pounds of steam per ton of seed, whereas screw-press and hydraulic mills averaged about 700 and 600 pounds, respectively. Steam usage per ton of seed ranged from about 900 to 1,700 pounds for solvent mills, from 400 to 1,500 for screw-press mills, and from 200 to 1,100 for hydraulic mills. Small hydraulic and screw-press mills used more steam per ton, on the average, than larger mills of the same type, but size of mill did not affect the amount of steam used by solvent-extraction mills.

Gas, coal, and fuel oil were used by the mills for producing steam. Gas was used by 64 percent of the mills, coal by 27 percent, and fuel oil by 9 percent. Fuel prices ranged from 7 to 80 cents per million British thermal units. The average price per million B. t. u. of fuel was 62 cents for fuel oil, 32 cents for coal, and 23 cents for gas. Mills run by steam power generally paid less per unit of fuel used than electric-powered mills in the same general area.

Screw-press mills in the Southwest that were steam-powered paid less per ton of seed for electric power and fuel combined, than electric-powered mills paid; however, part of this advantage was offset by the higher cost of boiler-room labor. Some mills that ranked high in usage of power and steam per ton ranked low in these costs per ton because they paid less per unit of electric power and fuel than the more efficient mills.

The prepress-solvent mill was the most efficient type for extracting oil, as measured by residual oil in meal. The percentages of oil left in meal, by type of mill, were (1) prepress-solvent, 0.9; (2) direct-solvent, 1.3; (3) screw-press, 4.2; and (4) hydraulic, 5.2. Hydraulic mills in the Valley area, however, with an average of 4.8 percent residual oil, were almost as efficient as screw-press mills in the Southeast which had an average of 4.7 percent residual oil in meal.

Mills that were most efficient in their use of labor were generally those that were also among the most efficient users of power and steam. Likewise, the most inefficient users of labor usually held about the same rank in power and steam usage.

The increasingly upward trend in wage rates makes it imperative to explore the possibilities of adopting more labor-saving machinery, particularly in areas of relatively low electric power rates.

INTRODUCTION

Labor and power are two major operating costs of cottonseed oil mills. Earlier studies have indicated wide variation among mills in the costs of these services, which accounted for about one-third of the total processing cost in 1950-51. 1/ The study on which this report is based is part of a broad program of research to help business firms handling farm products to operate more efficiently. The purpose of the study was to make available to mill operators information about the industry which would be useful to them in their efforts to achieve savings in man-hours and power.

Processing requirements and costs depend partly on factors over which the operator has limited control, such as availability and quality of seed, salability of products, and costs and prices. Labor and power usage, however, represent two principal items over which he has an appreciable measure of control, as he is sometimes able to substitute men for machines, or vice versa. But he is faced with questions regarding the most economical combination of men and machines for a given size of mill. How much could be gained from replacing men with machines? Is it justifiable to modernize the physical layout or replace outmoded equipment? Should capital be invested in equipment for a more efficient type of oil extraction process? Can the use of present facilities be improved? Can requirements for specific processing operations be reduced or eliminated? The purpose of this study is to assist in the resolution of such questions by enabling an operator to compare the performance of his mill with that of other mills similar in size, type, and other characteristics.

SURVEY OF MILLS

In line with this purpose, a sample was selected for analysis from the 286 cottonseed oil mills in the United States listed as active during the 1953-54 season. The sample was designed to include mills using all types of oil-extraction processes (hydraulic, screw-press, combination hydraulic and screw-press, and solvent-extraction), of varying sizes, and located in the 3 major cotton-producing areas. 2/ Because of the small number of solvent-

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1/ Spilsbury, C. C. Marketing and Processing Costs of Cottonseed-Oil Mills in the Postwar Period, 1946-47 to 1950-51. U. S. Prod. & Mktg. Admin., 61 pp., illus. 1952.

2/ Southeast, Southwest, and Mississippi Valley, hereinafter referred to as Valley.

extraction and combination hydraulic and screw-press mills, all the mills of these 2 classes were included in the sample, whereas a random selection was made of the hydraulic and screw-press mills. This random selection was based on the number of presses.

For purposes of this study it was determined that a sample of 100 mills was needed for a representative sample. To allow for expected nonrespondents and for very recent and unknown changes in types and total number of mills, a sample of 159 mills was developed. Of this number, 77 percent participated in the study.

Most of the nonrespondents did not have records available in the form desired, mainly because of the integration of their seed processing activities with other businesses. Others were going out of business or crushed no seed in the period covered by the schedule. Only a few did not wish to participate in the study. The numbers and types of mills that joined in the study are shown in table 1.

Table 1.--Distribution of sample cottonseed oil mills, by type of process, area and State

Area and State	Total	Hydraulic 1/	Screw press	Solvent 2/	Other 3/
	Number	Number	Number	Number	Number
United States	123	43	60	15	5
Southeast	37	21	14	2	---
Alabama	6	3	2	1	---
Georgia	9	6	2	1	---
North Carolina	11	8	3	---	---
South Carolina	11	4	7	---	---
Valley	39	16	13	9	1
Arkansas and Missouri	11	6	2	3	---
Louisiana	6	3	2	1	---
Mississippi	13	7	2	3	1
Tennessee	9	---	7	2	---
Southwest	47	6	33	4	4
Arizona	3	---	3	---	---
California	5	---	4	1	---
Oklahoma	7	---	7	---	---
Texas and New Mexico	32	6	19	3	4

1/ Includes 3 combination hydraulic and screw-press mills.
2/ Includes 2 mills that receive meats from other mills.
3/ Mills that only delint and hull cottonseed and send meats to other mills for crushing.

The Southeast and Valley areas each accounted for a little less than one-third of the sample mills, whereas 38 percent of the mills were located in the Southwest. Screw-press mills made up 49 percent of the sample, with hydraulic and solvent-extraction mills accounting for 35 and 12 percent, respectively. The remaining 4 percent of the mills only delinted and hulled seed. As only 3 combination hydraulic and screw-press mills reported, they are included with the hydraulic mills.

Interviewed by oil mill engineers, operators provided information on processing requirements for labor, power, fuel, and related items for the 1953-54 operating season and the 1954 calendar year. The engineers also sketched diagrams of the physical layouts of mill buildings, including the major machinery, as a means of better interpreting the quantitative data obtained from office records.

Seed crushed by the mills during the 1953-54 season was about 49 percent of the total United States crush (table 2).

Table 2.--Cottonseed crushed by all mills and by sample mills, by area and State, 1953-54

Area and State	All mills 1/	Sample mills reporting	
		Quantity	Percentage of total
	Tons	Tons	Percent
United States	6,255,946	3,086,075	49
Southeast	1,033,757	450,716	44
Alabama	290,862	81,233	28
Georgia	373,481	137,764	37
North Carolina	171,150	119,727	70
South Carolina	198,264	111,992	56
Valley	2,040,601	1,180,666	58
Arkansas	496,490	329,228	66
Louisiana	240,402	105,835	44
Mississippi	824,896	342,800	42
Tennessee	478,813	402,803	84
Southwest	3,005,666	1,410,539	47
Arizona	409,463	181,387	44
California	719,309	346,322	48
Oklahoma	143,084	91,894	64
Texas	1,733,810	790,936	46
All other States	175,922	44,154	25

1/ Bureau of the Census.

The 1954-55 crop was about 16 percent lower than that of the previous season, but seed received by the sample mills through January 1955 accounted for 54 percent of the total seed receipts in all mills (table 3).

Table 3.--Cottonseed received at mills, by area and State, August-January, 1954-55

Area and State	All mills 1/		Sample mills	
	Quantity	Portion of season's total	Quantity	Portion of U. S. total
	Tons	Percent	Tons	Percent
United States	4,944,792	95	2,653,453	54
Southeast	662,845	82	365,071	55
Alabama	2/172,546	77	69,828	40
Georgia	2/207,682	72	110,787	53
North Carolina	2/138,181	97	101,556	73
South Carolina	144,436	96	82,900	57
Valley	1,556,754	96	1,016,644	65
Arkansas	2/409,115	99	299,778	73
Louisiana	2/154,655	86	87,534	57
Mississippi	585,681	98	265,182	45
Tennessee	2/407,303	96	364,150	89
Southwest	2,355,131	90	1,214,264	52
Arizona	282,135	86	148,965	53
California	2/579,361	91	297,080	51
Oklahoma	2/ 89,384	98	62,531	70
Texas	1,404,251	90	705,688	50
All other States	2/1,370,062	---	57,474	---

1/ Bureau of Census, Bull. 192, Cotton Production and Distribution.
2/ Receipts for August in Alabama, Georgia, North Carolina, Arkansas, Louisiana, Tennessee, California, and Oklahoma are included in "All other States."

GENERAL CHARACTERISTICS OF MILLS AFFECTING LABOR AND POWER USAGE

The most important influence on the amount of labor and power needed is the type of oil-extraction equipment used. However, other important factors are: (1) Size of mill, annual crush, and length of operating season, (2) type of business in which mills engage other than cottonseed processing, and (3) cottonseed qualities and product yields.

Size of Mill, Annual Crush, and Length of Operating Season

Size of mill is here measured in terms of the normal daily crushing capacity reported by each mill.

Mills varied in size from 25 tons per day to almost 500. All mills with a daily capacity of more than 200 tons were located in the Valley and Southwest areas. Almost 50 percent of the 123 mills surveyed were 100 tons per day and under in size, whereas only about 10 percent were over 200 tons. In the Southeast, which had the largest number as well as the largest percentage of small mills, more than 25 percent were 50 tons and under, and almost 70 percent were 100 tons per day and under. The largest mills were located in the Southwest area, with 10 percent being over 250 tons per day.

Annual crushes varied considerably for the same size of mills (fig. 1). Mills with daily crushing capacities from 51 to 100 tons had annual crushes ranging from less than 5,000 to more than 20,000 tons. The largest mills, crushing over 250 tons per day, had annual crushes exceeding 50,000 tons.

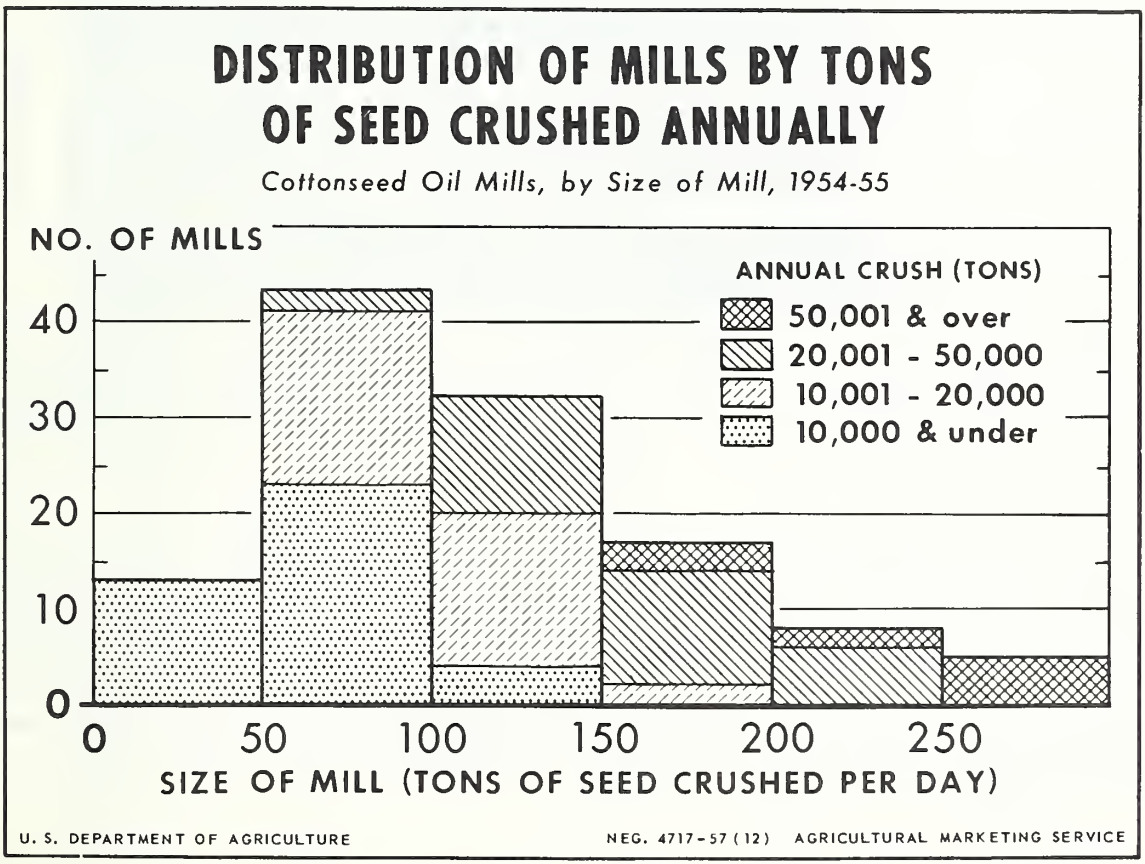

Figure 1

Because of a short crop, the industry crushed only 84 tons of seed in 1954-55 for every 100 tons crushed in the previous season. One-third of the sample mills had crushes of 10,000 and under in 1954-55, compared with only one-fourth of the mills in the bigger crop year of 1953-54 (fig. 2). About 25 percent of the mills crushed one-third less in 1954-55 than in 1953-54.

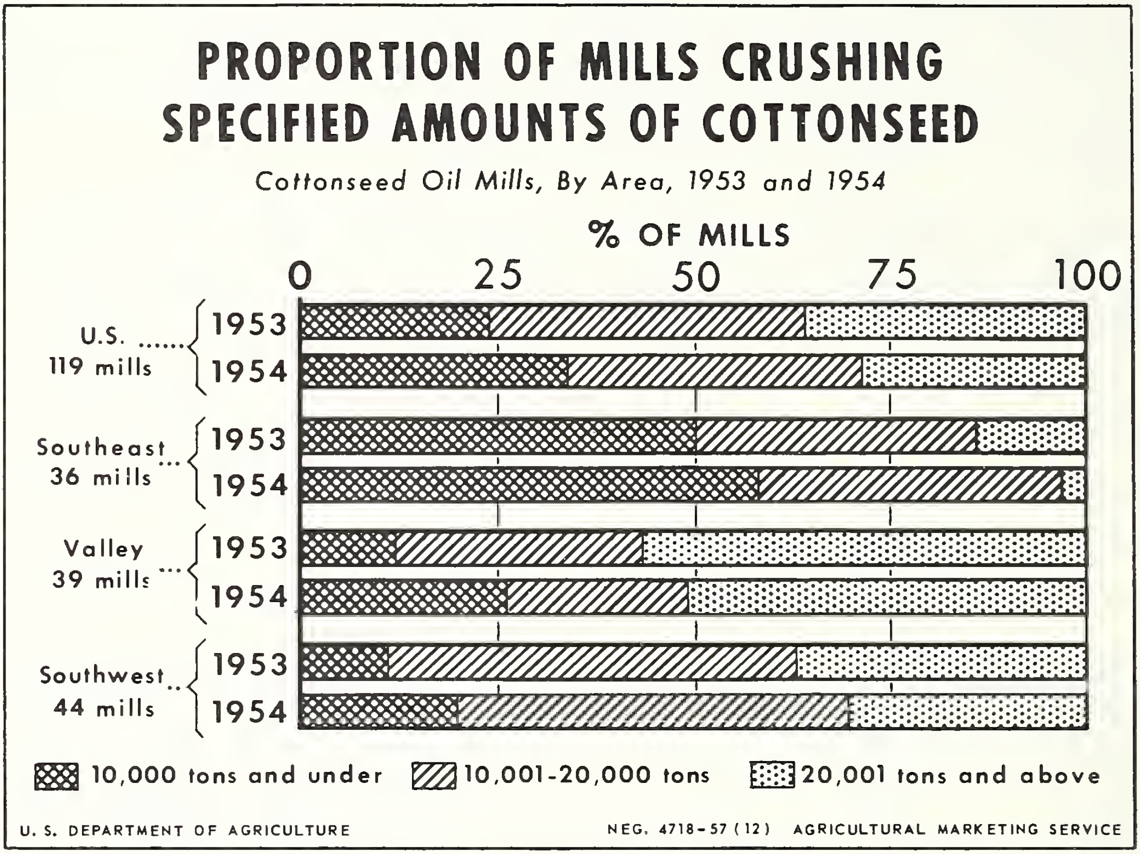

Figure 2

A short seed supply intensifies the competition for seed, to the disadvantage of small mills. Large mills frequently can outbid small mills for seed and an equal decrease for large and small mills is a much higher proportion of the small mill's total crush. This is illustrated by the fact that during 1954-55 mills with daily crushing capacities of 100 tons per day and under suffered an average reduction of 26 percent (2,900 tons) in their annual crushes, compared with only 11 percent (3,800 tons) for all larger mills (table 4).

Table 4.--Size, annual crush, and length of operating season of cottonseed oil mills, 1953-54 and 1954-55

Area and size of mill (tons per day)	Mills reporting	Average capacity per mill per day	Seed crushed per mill 1/ 1953-54	Seed crushed per mill 1/ 1954-55 Quantity	Seed crushed per mill 1/ 1954-55 Percentage change from 1953-54	Length of season per mill, 1954-55 estimate 1/ Months	Length of season per mill, 1954-55 estimate 1/ Days per month
	Number	Tons	Tons	Tons	Percent	Number	Number
United States ...	108	122	24,300	20,800	-18	7.1	21
50 and under ..	13	38	4,600	3,100	-34	5.3	16
51 - 100	40	82	13,000	9,900	-23	6.4	19
101 - 150	31	125	23,400	19,400	-15	7.3	21
151 - 200	13	182	34,700	36,500	+6	9.2	25
201 - 250	7	235	53,200	39,600	-26	7.6	24
251 - 500	4	376	111,400	107,800	-4	11.5	29
Southeast	32	84	11,200	8,800	-24	6.0	17
50 and under ..	9	38	4,000	2,700	-35	4.9	14
51 - 100	13	79	10,400	8,100	-27	6.3	17
101 - 150	8	120	16,700	13,900	-12	6.5	18
151 - 200	2	178	22,900	17,400	-21	7.0	--
Valley	33	127	26,200	22,600	-14	7.6	22
50 and under ..	2	40	6,100	3,700	-41	5.5	17
51 - 100	13	79	13,800	10,600	-25	6.5	20
101 - 150	10	134	26,300	25,800	+2	8.7	23
151 - 200	3	193	39,100	42,400	+9	9.3	25
201 - 250	5	235	56,100	43,100	-24	8.4	23
Southwest	43	146	32,500	28,300	-16	7.6	23
50 and under ..	2	35	5,500	4,000	-23	7.0	23
51 - 100	14	87	14,500	11,000	-19	6.4	21
101 - 150	13	122	25,500	17,700	-31	6.8	22
151 - 200	8	178	36,000	39,000	+12	9.6	25
201 - 250	2	235	45,800	30,900	-30	5.5	27
251 - 500	4	376	111,400	107,800	-4	11.5	29

1/ Excludes a few mills for which data were unavailable.

Southeastern mills averaging 84 tons per day in size had an average reduction of 22 percent in seed supplies. This compares with reductions of 12 percent by both the Valley and Southwestern mills, which averaged 127 and 146 tons per day in size, respectively.

Operators met the problem of reduced crushes in different ways. Some operated the usual number of months, by operating fewer days per month; others operated about the same number of days as before, but with smaller daily crushes; still others ran their mills at or near their normal daily and monthly capacities, but worked fewer months per year. For example, a small mill under 100 tons per day in size, having a 25-percent cut in seed supplies, operated for the same number of months but cut the average number of days per month from 26 to 20. A somewhat larger mill with 15 percent less seed, operated about the same number of months and days per month as in the previous season, but at about 90 percent of its normal daily capacity.

For the most part, length of season increased with the size of mill in terms of both operating months and operating days (table 4). However, because of the different operating practices, the length of season varied widely for mills of the same size.

In some measure differences in the length of operating season for mills in the 3 areas, shown in fig. 3, reflect differences in the size of annual crush. For example, in the Southeast, which had the smallest annual crushes, only 2 mills operated over 8 months, compared with 14 mills in the Valley and 18 in the Southwest. The average length of season for the industry was about 7 months. This compared with an average of 6 months for Southeastern mills, and 8 months for Valley and Southwestern mills.

Sideline Activities

Some of the mills engaged in numerous businesses besides the processing of cottonseed, which influenced the amount of labor and power used. In some cases these mills could use labor and power more economically than similar mills that only processed cottonseed. Among these other activities are the delinting of seed for planting, crushing other oilseeds, operating mixed feed plants, cotton gins, ice plants, fertilizer plants, grain elevators, insecticide plants, vegetable oil refineries, and cotton spinning and weaving mills. Many of these other businesses provided employment for workers during the dormant seasons of mills. Although the mills were not questioned about their sideline activities, about one-third of the 123 mills in the sample (40 mills), indicated that they engaged in one or more of these other businesses. These 40 mills were distributed in different regions as follows:

Area	Mills reporting sideline activities
	Number
Southeast	13
Valley	15
Southwest	12

Some of these 40 mills could not segregate all of the materials and services used in cottonseed processing from those used in their other activities. For example, a mill crushing cottonseed and soybeans in the same months might keep no breakdown of labor, electric power, and fuel used in each of these operations. Or a mill operating a refinery might keep separate records for the amounts of electric power and fuel used in its seed processing and refinery operations, and yet not keep such a breakdown on the amount of labor used. In a few instances satisfactory estimates could not be made of the power and fuel used in these other activities. Where this was true, the mills were omitted from the power and fuel analysis.

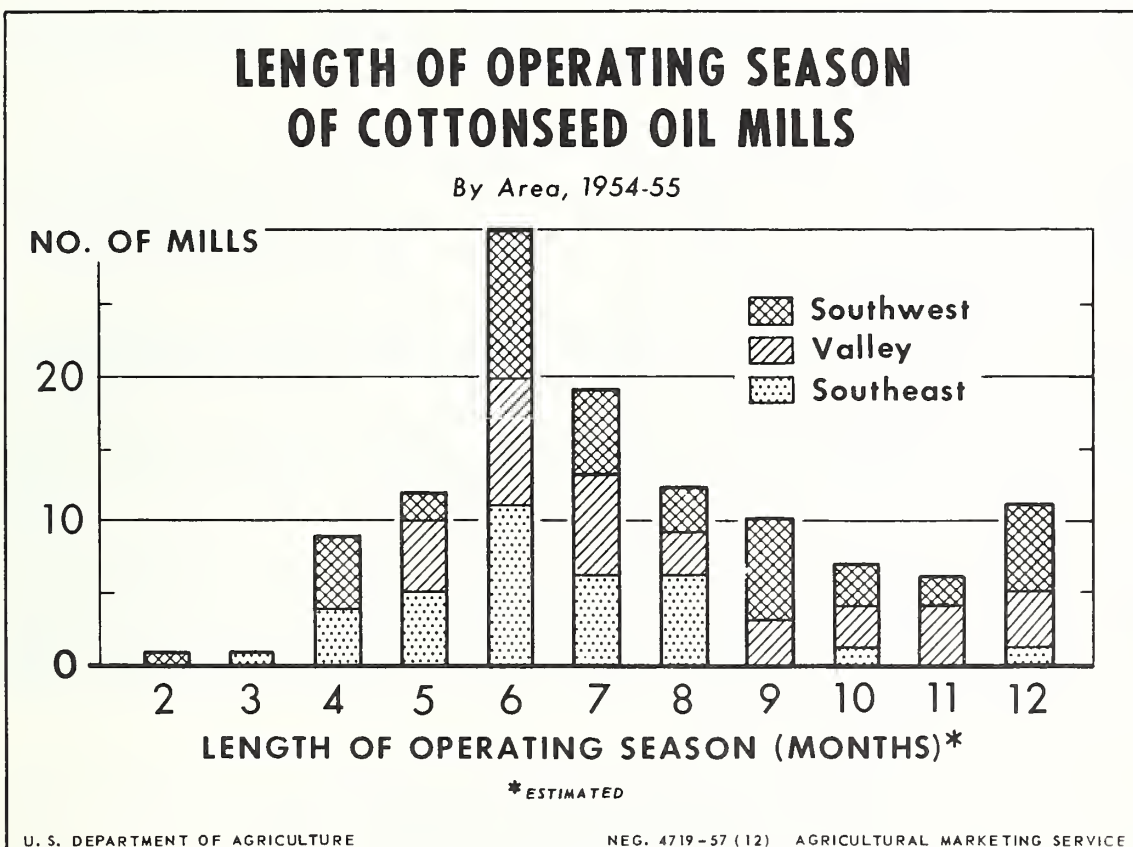

Figure 3

Cottonseed Qualities and Product Yields

Area differences in seed qualities partially account for differences among mill operating requirements, costs, and product yields. For example, the amount of foreign material (such as sticks, shale, and fine trash) affects the amount and type of seed cleaning machinery needed, the labor and power requirements, and maintenance and repair costs. Foreign material can cause a storage problem, as certain moist materials, such as weeds or weedseed, may contribute to the deterioration of the cottonseed and may also affect the quality of linters produced. If seed is sterilized before cleaning, the foreign material is especially hard to remove, becoming imbedded by the steam.

The amount of moisture in seed affects the yield of products produced per ton of seed received as well as the power used for seed storage. As indicated in table 5, the seed in the different areas varies considerably with respect to both foreign material and moisture content. Southwest seed averaged the most foreign material in both 1953-54 and 1954-55, having almost twice as much as seed in the Southeast and Valley areas. However, in the same 2 seasons, moisture content of seed in the Southwest was lower than in the other areas.

Certain varieties of seed are less costly to process than others. Where a large percentage of the crush was pima seed (having low linters yield, high hull and oil yield), the mills required appreciably less power than mills elsewhere.

The oil content of seed processed by the sample mills was about the same as that of all mills in the same areas (table 6). In no instance was the difference more than 3 percent; therefore, it was assumed that the other seed qualities would be about the same for the sample mills as for all mills.

Product yields per ton of seed for sample mills are shown in table 7 by area for the different types of processes. This table also includes seed qualities which have the greatest effects on product yields. The estimate of manufacturing loss (difference between the weights of seed and seed products) is not strictly accurate, as some mills produced minor products, such as grabbots and motes, which are not here included in the total product yield.

As shown in table 7, Valley mills processed seed with the highest oil content and also extracted more oil than mills in the Southeast and Southwest. The oil yield in hydraulic mills in the Valley was over 5 percent more than that in screw-press mills in the Southeast, but this difference is not equivalent to differences in extraction efficiencies since the oil content of the seed processed was not the same.

UTILIZATION AND COSTS OF LABOR, POWER, FUEL, AND RELATED ITEMS

In order to minimize the effect of differences in operating practices on labor, power, and fuel requirements, the mills studied here were grouped by

Table 5.--Foreign material in and moisture content of cottonseed received at all oil mills, by area and State, 1953-54 and 1954-55 1/

Area and State	Foreign material 1953	Foreign material 1954	Moisture 1953	Moisture 1954
	Percent	Percent	Percent	Percent
United States	0.8	1.0	9.0	9.2
Southeast	.6	.6	10.1	8.9
Alabama	.5	.6	9.5	8.4
Georgia	.7	.5	10.9	8.5
North Carolina	.6	.9	10.1	9.6
South Carolina	.5	.6	10.3	9.1
Valley	.6	.9	8.9	10.0
Arkansas	.8	1.2	8.7	10.0
Louisiana	.6	.7	9.4	10.3
Missouri	.8	1.0	8.5	11.5
Mississippi	.5	.7	9.0	9.4
Tennessee	.6	.8	8.8	10.3
Southwest	1.2	1.2	8.5	8.1
Arizona	1.5	1.3	6.5	7.1
California	.8	.8	10.0	9.4
New Mexico	2.2	1.9	7.7	8.0
Oklahoma	.9	.8	9.4	8.0
Texas	1.3	1.4	8.3	7.9

1/ Excludes American-Egyptian cottonseed. U. S. Department of Agriculture, Cottonseed Quality in the U. S., 1953-1954. January 1956.

type, size, and area for purposes of analysis. In addition to data on labor, power, and fuel, information was obtained on mill maintenance and repair costs, supplies (such as press cloth, filter cloth, and solvent), and oil yields (for measuring extraction efficiency).

Some mills were unable to report on all items requested. These mills are not included in the phases of the study involving these items, but they are included in other phases.

Size of mill is measured by the normal daily operating capacity as reported by the mill, unless otherwise stated. As previously mentioned, the mills analyzed vary from 25 to almost 500 tons processed per day and from less than 1,000 to more than 100,000 tons per year; the larger mills are located in the Valley and Southwest areas (table 4). Type of mill does not differentiate between the modern, or high-speed, screw-press and the older, low-speed type.

Table 6.--Oil content of cottonseed processed by all mills and sample mills, 1953-54

Area and State	Total mills 1/	Sample mills
	Percent	Percent
Southeast	18.4	18.1
Alabama	18.3	17.9
Georgia	18.4	18.1
North Carolina	18.6	18.4
South Carolina	18.3	18.0
Valley	18.9	18.9
Arkansas	19.0	18.9
Louisiana	18.6	18.5
Missouri	18.9	18.9
Mississippi	18.9	18.7
Tennessee	19.3	19.1
Southwest	18.7	18.7
Arizona	19.7	19.8
California	18.8	18.9
New Mexico	19.9	20.3
Oklahoma	17.5	17.3
Texas	18.6	18.4

1/ Compiled from U. S. Dept. Agr., Cottonseed Quality in the United States, 1953-54. January 1956.

Several screw-press mills reported being high-speed, but very few, if any, had had enough normal operating experience with this process before 1954-55 to be analyzed as a separate group.

Labor

This report considers 3 types of labor--temporary (peak season), normal operating, and dormant-season.

Seed unloading, sterilizing, conditioning, sampling, and storing are primarily limited to the periods of heavy seed receipts. Temporary or peak-season labor is defined as that which was used only in peak-season operations.

Normal operating labor is considered to be all labor, exclusive of that used in temporary operations, which is needed in any 24-hour day when the mill is running at or near its normal crushing capacity. Otherwise expressed, normal labor is that which is needed to man the mill on any typical day.

Table 7.--Cottonseed quality, yield of products, and manufacturing loss per ton of seed, by area and type of mill, 1953-54

Area	Cottonseed quality, 1953 crop 1/	Product yield by type of mill: All	Hydraulic	Screw press	Solvent extraction
	Percent	Pounds	Pounds	Pounds	Pounds
Oil					
Southeast	18.4	313	309	310	2/
Valley	18.9	344	328	334	366
Southwest	18.7	334	290	332	369
Meal					
Southeast	3.97	976	989	982	2/
Valley	4.00	946	954	948	937
Southwest	4.03	975	910	992	940
Linters					
Southeast	13.1	227	220	241	2/
Valley	10.7	192	196	190	191
Southwest	11.6	193	219	198	148
Hulls					
Southeast		412	410	396	2/
Valley		469	468	488	457
Southwest		455	434	447	507
Manufacturing loss 3/					
Southeast	10.1	72	72	71	2/
Valley	8.9	49	54	40	49
Southwest	8.5	43	147	31	36

1/ Cottonseed qualities shown for oil, meal, linters, and manufacturing loss are oil, ammonia, linters, and moisture content. Oil content is that reported by sample mills, whereas the other qualities are for U. S. seed. Linters content is for the 1954-55 season, the first year of available data, and given only to show relative differences between areas.

2/ Not shown individually as only 1 mill reported, but included in total.

3/ Manufacturing loss is lower than amounts shown as it includes production of minor products such as hull fiber, hull bran, motes, and grabbots. Not enough data were reported for reliable estimates.

Dormant-season labor is that which is kept on hand between the end of one operating season and the beginning of the next.

Labor for the first two categories was reported for the biggest operating month of 1954, whereas for dormant labor, operators reported the amount of labor kept on hand between operating seasons.

Temporary (Peak-Season) Labor

In general, the use of temporary daily labor increased as the size of mill increased in each area. Most temporary labor is used for unloading and storing seed. Table 8 shows the average amount of temporary labor used per day per mill for different mill sizes, and the corresponding quantities of seed unloaded and stored in the big month. Labor for seed sampling is included in seed unloading. Only 6 mills reported labor for sterilizing seed (5 in the Southwest, and 1 in the Valley); they averaged about 24 man-hours per day for this operation.

Valley mills used more labor, in general, than those in other areas for unloading as well as storing seed. Mills in the Southeast had smaller annual crushes, and therefore unloaded and stored less seed per month, than mills of similar size in the Valley. Although Southwest mills had the highest average annual crush, several of them stored seed outside in ricks (piles), and thus used less labor than if seed were unloaded and stored in seed houses.

Temporary labor is used approximately 3 months a season in most mills. Nearly 95 percent of the mills received at least 75 percent of their seed during a 3-month period, and over three-fifths received at least 90 percent during such a period. The calendar months within which this period falls are shown in table 9.

The majority of mills, 60 percent, reported no labor designated for seed storage. It was assumed in these cases that seed unloading labor was used for storing seed also, when needed, especially since the biggest month for storing seed generally followed the biggest month of seed receipts, as shown in table 10. For most mills the month of greatest seed receipts was either September or October, and for seed in storage at the end of the month, the big month was either October or November.

Seed Unloading Facilities

Man-hours required for unloading seed vary with the type, number, and capacity of unloaders. Cottonseed was unloaded at the mills by pneumatic unloaders, fork trucks, power shovels, power lifts (dumper), and by hand, either alone or in combination (table 11). The power lift, the most efficient type of unloader in terms of labor required, was used by only 16 percent of the mills, all located in the Valley and Southwest areas. These mills were generally big ones, unloading at least 10,000 tons of seed in the month of greatest

Table 8.--Number of cottonseed oil mills reporting, seed crushed, unloaded, and stored, storage capacity as percentage of crush, and labor used to unload and store seed in "big month," by area and size of mill, 1954-55

Area and size of mill (tons per day)	Mills reporting	Seed crushed in season 1/	Maximum months 1/ Seed unloaded	Maximum months 1/ Seed in storage	Storage capacity as percentage of crush 1/	Labor per day 1/ Total	Labor per day 1/ Unloading	Labor per day 1/ Storage
	Number	Tons	Tons	Tons	Percent	Man-hours	Man-hours	Man-hours
United States	107	20,800	8,700	11,600	47	61	50	11
50 and under	13	3,100	1,300	1,000	31	24	23	1
51 - 100	39	9,900	4,400	5,000	45	44	32	12
101 - 150	31	19,400	8,400	10,300	48	76	64	12
151 - 200	13	36,500	15,000	21,200	56	85	78	7
201 - 250	7	39,600	16,000	20,100	49	65	62	3
251 - 500	4	107,800	44,000	73,000	69	138	94	44
Southeast	32	8,800	3,700	3,600	38	45	33	12
50 and under	9	2,700	1,100	900	30	22	21	1
51 - 100	13	8,100	3,300	3,500	41	41	26	15
101 - 150	8	13,900	6,200	6,200	43	72	49	23
151 - 200	2	17,400	7,500	7,700	45	72	72	0
Valley	32	22,600	9,700	12,800	51	72	61	11
50 and under	2	3,700	1,900	1,400	32	42	42	0
51 - 100	12	10,600	5,200	5,800	50	52	38	14
101 - 150	10	25,800	10,500	14,400	53	106	90	16
151 - 200	3	42,400	17,100	24,000	55	71	66	5
201 - 250	5	43,100	17,300	24,000	55	69	66	0
Southwest	43	28,300	11,800	16,700	50	64	54	10
50 and under	2	4,000	1,600	1,200	31	18	18	0
51 - 100	14	11,000	4,700	5,900	46	41	33	8
101 - 150	13	17,700	8,200	9,300	47	57	55	2
151 - 200	8	39,000	16,100	23,600	59	94	84	10
201 - 250	2	30,900	12,600	10,400	34	56	44	12
251 - 500	4	107,800	44,000	73,000	69	138	94	44

1/ Per mill.

Table 9.--Periods of heaviest seed receipts for cottonseed oil mills, by area, 1954-55

Period	Southeast	Valley	Southwest
	Percent	Percent	Percent
Crushing season	100	100	100
June-August	---	---	5
July-September	3	---	5
August-October	22	12	14
September-November	72	88	34
October-December	3	---	42

Table 10.--Distribution of cottonseed oil mills by month of greatest seed receipts and seed storage, by area, 1954-55 1/

Month	Seed receipts				Seed in storage at end of month			
	All areas	South-east	Valley	South-west	All areas	South-east	Valley	South-west
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Total	100	100	100	100	100	100	100	100
July	2	0	0	5	0	0	0	0
August	9	10	3	14	7	7	0	12
September	39	56	53	16	12	9	10	16
October	35	28	44	33	29	56	28	9
November	11	6	0	23	33	16	56	28
December	4	0	0	9	17	3	6	35
January	0	0	0	0	3	9	0	0

1/ Based on reports of 32, 32, and 43 mills in the Southeast, Valley, and Southwest areas, respectively.

receipts in 1954-55 and almost all of them processed over 20,000 tons in 1953-54. About 70 percent of the mills used a pneumatic seed unloader (including those using it along with another type). The power shovel, which required more labor for similar tonnages than any other method, was used by 21 percent of the mills. All mills unloading seed primarily by hand were located in the Far West, where seed is usually stored outside the mill buildings in piles, or ricks.

Table 11.--Labor used per day for unloading seed in month of greatest seed receipts in cottonseed oil mills, by type of equipment and area, 1954-55

Equipment and area	Mills reporting-- Equipment	Mills reporting-- Equipment, seed unloaded, and unloading labor	Seed unloaded per mill	Seed unloading labor per mill per day
	Number	Number	Tons	Man-hours
Pneumatic	68	66	6,000	43
Southeast 1/	27	26	3,700	32
Valley	13	13	8,200	46
Southwest	28	27	7,300	53
Power lift (Dumper)	15	11	17,800	63
Valley	6	4	12,200	44
Southwest	9	7	20,900	73
Power shovel	14	13	6,900	70
Southeast	5	5	2,900	38
Valley	9	8	9,400	89
Hand--Southwest	7	6	25,800	51
Fork truck--Southwest	1	1	---	---
Pneumatic and power shovel	10	5	---	---
Southeast	5	1	---	---
Valley	5	4	9,200	109
Power lift and other 2/	5	3	---	---
Valley	4	2	18,700	28
Southwest	1	1	---	---

1/ Includes 1 mill using hand labor in combination with pneumatic unloader.
2/ Includes following combinations: Power lift and pneumatic; power lift and power shovel; and power lift, pneumatic, and power shovel.

Seed Storage Facilities

There appeared to be no relationship between type and number of storage facilities and labor used for seed storage, although some mills that unloaded seed at several separate houses did use an unusual amount of labor.

The plant layouts, received from 93 of the mills (over 75 percent of those surveyed), showed that the majority used houses for storing seed, less than 5 percent used tanks or silos, and about 15 percent used both houses and tanks.

These percentages are about the same as those reported in a recent survey of all cottonseed oil mill storage facilities. 3/ Mills having tank storage facilities were located mainly in the Southeast and Valley, and most of them processed soybeans in some years as well as cottonseed. About 5 percent of the mills had seed storage sections in the main mill buildings, and another 5 percent had storage houses connected to the main mill buildings. Most mills in the Far West that stored seed in piles had no storage houses.

The makeup, number, and size of the seed storage facilities varied widely. More than 25 percent of the mills, mostly in the Valley and Southeast areas, had facilities for seed cleaning in the storage houses. Fifteen percent of the mills had the houses partitioned into sections for seed storage, while ten percent had sections for storing products (meal and hulls) and machinery. Also, 10 percent had seed bins, about half of which were located within the houses and the others separate from the houses. Some mills had sample rooms in the seed houses, but other mills had separate buildings for sampling. A few mills processed or sacked meal in the seed house.

The largest number of seed houses shown for any 1 mill was 5, compared to 8 tanks and a combination of 8 tanks and 1 house. However, the majority of the mills had only 1 seed house.

Normal Daily Operating Labor

The number of workers for a typical (normal) day was reported for the following departments or operations:

Moving seed from storage
Seed cleaning
Linter room (including saw filers, changers, and oiler)
Bale-press room
Huller-separation room
Press room or oil-extraction (including preparation and solvent operators in direct-solvent mills and screw-press operators in prepress-solvent mills)
Meal room
Hull storage and loading
Boilerroom (including workers who operate machinery for generating power)
Yard and cleanup (excluding janitors)
Maintenance
All others

Superintendents and laboratory personnel were reported, but are considered separately, and are not included in total normal daily labor.

3/ Gilliland, C. B., and Jackson, Donald. Tank Storage of Fats and Oils and Mill Storage of Oilseeds and Their Products. U. S. Dept. Agr., Mktg. Res. Rpt. No. 122, 46 pp., illus. May 1956.

Labor was measured in terms of man-hours, instead of number of men. This choice was necessary because 53 percent of the mills worked on two 12-hour shifts per day, 7 percent on one shift of 12 hours or less per day, and the remainder worked on three 8-hour shifts (table 12). Any mill with two 12-hour shifts obviously would have 1/3 less men on its payroll than if it had three 8-hour shifts, even though the number of man-hours used per day would be the same.

The 8 mills operating for only 1 shift of 12 hours or less ranged in size from 50 to 160 tons per 24-hour day. These mills received an average of 40 percent less seed in 1954-55 than in the previous season, but 5 of them indicated that they engaged in sideline activities.

More than 75 percent of the hydraulic mills operated on 12-hour shifts compared to 20 percent of the solvent-extraction mills. The Valley had the lowest percentage (about 45) of mills on 12-hour shifts.

Normal daily capacity was used in comparing man-hours in the different mills. Normal daily labor per ton of seed was estimated by dividing the total man-hours used in a typical 24-hour day by the normal daily capacity.

In the following paragraphs, normal daily labor is analyzed in two stages. First, different types of mills are compared with respect to their total labor requirements. Second, they are compared with respect to the following categories:

(1) Preliminary labor (labor required for all operations before the oil-extracting process, beginning with moving seed from storage).

(2) Labor for extracting oil.

(3) Labor for processing meal, storing and loading hulls, and operating boilerroom.

(4) All other labor.

Total

Man-hours per ton of seed decreased, on the average, with increase in the size of mill for all types of mills (fig. 4). The hydraulic mills ranked highest in labor usage and solvent-extraction mills the lowest. Screw-press mills, however, averaged less man-hours per ton than solvent-extraction mills of about the same size.

Both the hydraulic and screw-press mills had a greater savings in man-hours per ton of seed, on the average, as the size of mill increased, than the solvent-extraction mills. In mills with capacities from about 150 to 250 tons per day, labor decreased from 3.9 to 2.6 man-hours per ton for hydraulic mills, from 2.8 to 2.0 for screw-press mills, but only from 2.7 to 2.5 for the

Table 12.--Number of operating shifts per 24-hour day, by type of cottonseed oil mill, area, and State, 1954-55

Area and State	Total mills in sample	Mills operating on-- One 12-hour shift: Total	One 12-hour shift: Hy-draulic	One 12-hour shift: Screw-press	Two 12-hour shifts: Total	Two 12-hour shifts: Hy-draulic	Two 12-hour shifts: Screw-press	Two 12-hour shifts: Solvent	Two 12-hour shifts: Other 1/	Three 8-hour shifts: Total	Three 8-hour shifts: Hy-draulic	Three 8-hour shifts: Screw press	Three 8-hour shifts: Solvent
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
United States	2/ 123	8	7	1	65	25	32	3	5	49	11	26	12
Southeast	2/37	6	5	1	20	12	7	1	--	10	4	5	1
Alabama	5	--	--	--	4	2	1	1	--	2	1	1	--
Georgia	9	1	1	--	3	3	--	--	--	5	2	2	1
North Carolina	11	2	2	--	6	5	1	--	--	3	1	2	--
South Carolina	2/11	3	2	1	7	2	5	--	--	--	--	--	--
Valley	39	2	2	--	15	8	5	1	1	22	6	8	8
Arkansas and Missouri	11	--	--	--	3	3	--	--	--	8	3	2	3
Louisiana	6	2	2	--	2	1	1	--	--	2	--	1	1
Mississippi	13	--	--	--	7	4	1	1	1	6	3	1	2
Tennessee	9	--	--	--	3	--	3	--	--	6	--	4	2
Southwest	47	--	--	--	30	5	20	1	4	17	1	13	3
Arizona	3	--	--	--	--	--	--	--	--	3	--	3	--
California	5	--	--	--	--	--	--	--	--	5	--	4	1
Oklahoma	7	--	--	--	6	--	6	--	--	1	--	1	--
Texas and New Mexico	32	--	--	--	24	5	14	1	4	8	1	5	2

1/ Mills that only delint and hull cottonseed and send meats to other mills for crushing.
2/ No information reported for 1 mill.

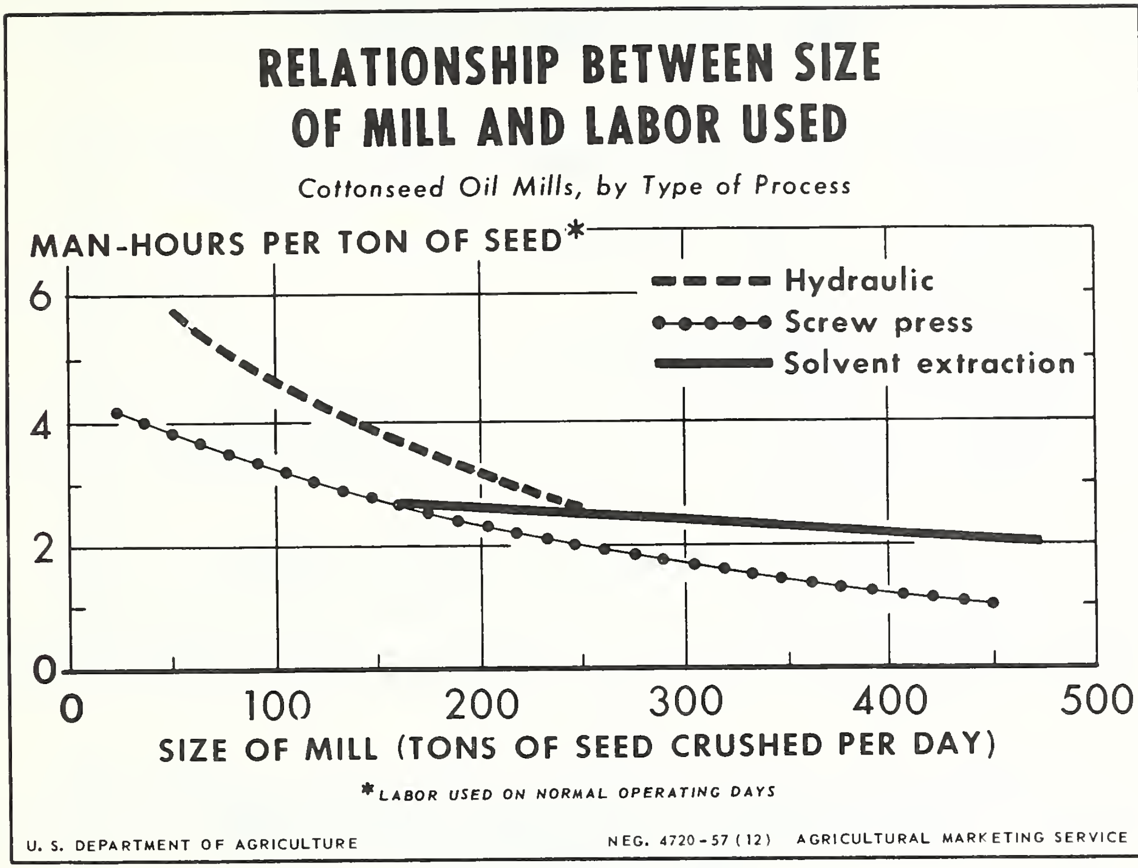

Figure 4

solvent-extraction mills. Nearly 45 percent of the variation in labor used was accounted for by difference in size of mill for all 3 types. Thus more than one-half of the variation in labor used was due to factors other than size.

Several small mills used more total man-hours per day than some larger ones did (fig. 5). Specific screw-press mills between 75 and 250 tons per day (a difference of 175 tons) all used between 300 and 350 man-hours per day. All screw-press mills of 100 tons and less used from 100 to more than 400 man-hours, whereas hydraulic mills of similar size used from 250 to more than 500.

Some of the wide range in man-hours used by mills of the same size was related to location. Comparison of man-hour requirements by mills in the 3 areas was possible for the hydraulic and screw-press mills only, as the number of solvent-extraction mills was too small. In terms of the average relationship between size of mill and normal labor used per ton of seed, as shown in figure 6, hydraulic mills in the Valley area generally used more labor than

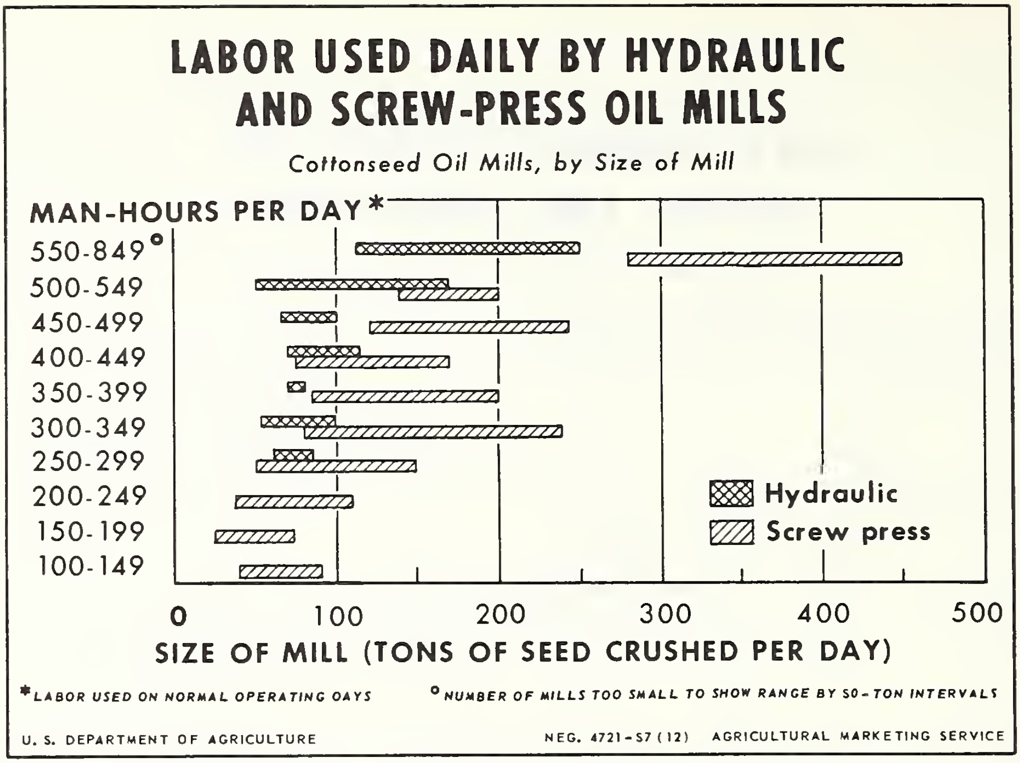

Figure 5

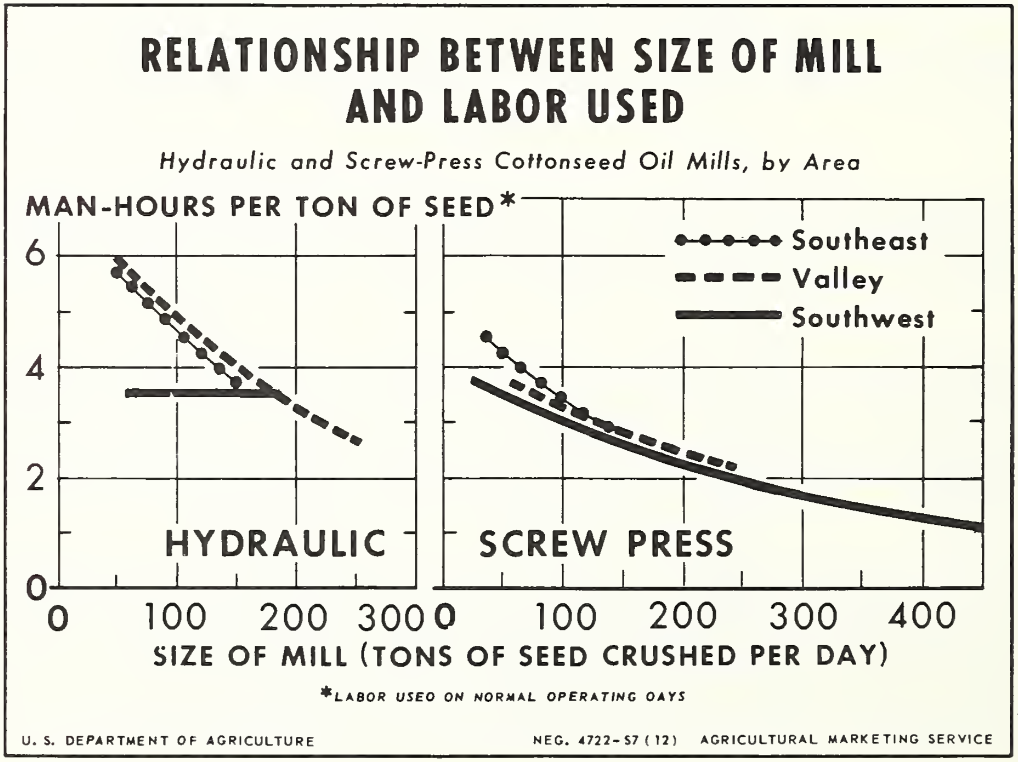

Figure 6

those in the Southeast or Southwest. The number of hydraulic mills in the Southwest was too small to get a valid picture of differences due to size, but a line showing labor used in these mills is included in figure 6 so that an approximate comparison can be made of the 3 areas.

Similar relationships for screw-press mills are also shown in figure 6. Screw-press mills in the Southwest used, on the average, less labor than those in either the Valley or Southeast areas.

Preliminary Labor

Preliminary labor includes labor used in moving seed from storage, cleaning the seed, and for operations in the linter room, the huller-separation room, and the bale-press room. These operations accounted for almost one-half of the total normal labor used by screw-press mills, 40 percent of that used by the solvent-extraction type, and about one-third of that used by hydraulic mills.

Most mills operated their linter rooms and other departments for preparing for oil extraction 24 hours a day. Only 4 mills reported running their linter rooms for a shorter day. Mills with sufficient linter-room capacity sometimes operate these preparation departments fewer shifts per day than their extraction departments to save labor.

Some mills try to save labor by operating their linter rooms the same number of shifts as their extraction departments but fewer days per week. This practice requires storage facilities for the overflow of delinted seed. Some mills in the Southwest and Valley areas had such facilities. Since available data were not sufficient to determine the extent to which this practice might result in net labor savings per ton of seed, the analysis was limited to man-hours used on a typical operating day.

As shown in figure 7, there were distinct differences in amounts of preliminary labor used by type of mill. Solvent-extraction mills used on the average more man-hours per ton than either the hydraulic or screw-press, and 175- to 250-ton hydraulic mills used less than screw-press mills of similar size. More than 50 percent of the variation in man-hours used by hydraulic mills was accounted for by size, compared with 30 percent for the screw-press, whereas size had little or no effect on the amount of labor used by the solvent-extraction type.

Comparison by area shows that mills in the Valley with capacities up to almost 300 tons per day used, on the average, the highest amount of preliminary labor. Differences in the size of mills accounted for about 55 percent of the variation in man-hours used per ton of seed by mills in the Valley, but for only 25 percent by those in the Southeast and the Southwest (fig. 8).

Some of the variation in preliminary labor used per ton of seed was due to differences in plant layouts. Several mills using low amounts of labor

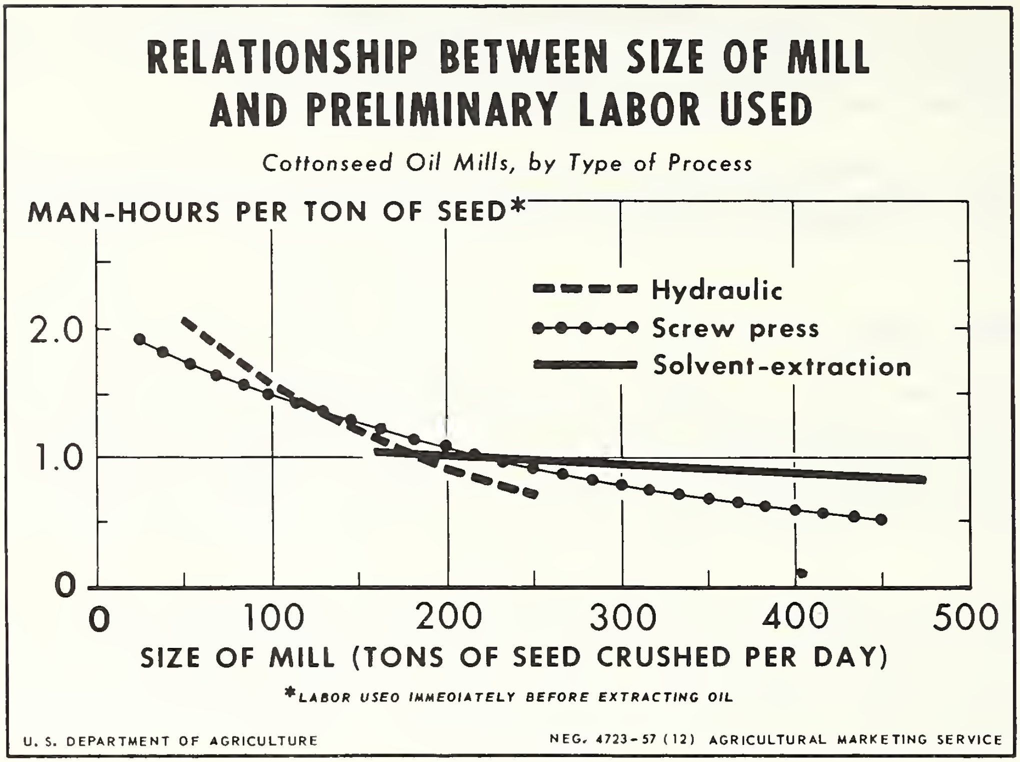

Figure 7

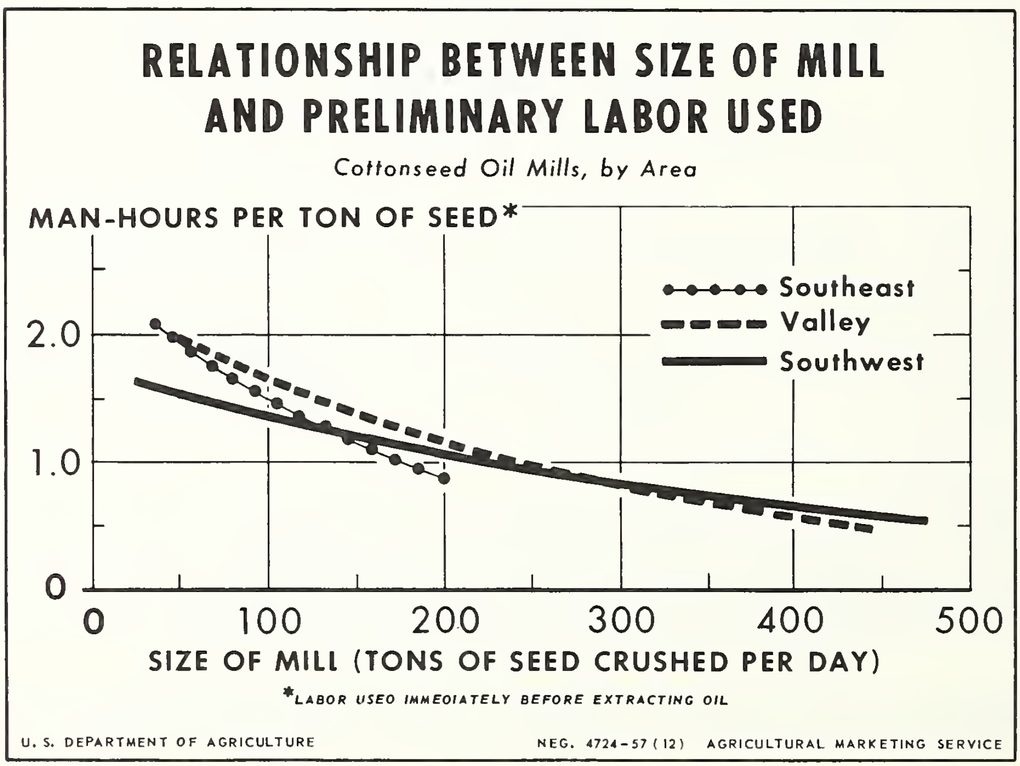

Figure 8

for moving seed from storage, either had seed bins, machinery for seed suction, or storage houses connected to the mill building. A few mills in the Southwest contracted for this operation. No mill for which the plant layout showed a seed bin used more than 24 man-hours per day for moving seed from storage.

Most mills using small amounts of seed-cleaning labor had this operation in close proximity to the linters' and hullers' section, or had all 3 operations in an unpartitioned room, with either huller or linter men performing this operation also. The same held true for huller-separation labor. The plant layouts showed that about 30 percent of the mills had the seed cleaned in the seed storage house, 10 percent in separate buildings, and more than 50 percent had the seed cleaned in the main mill building. Mills using extra large amounts of labor for huller-separation and linters baling were also extra large users of linter-room labor. For mills using less labor than most, the layout generally was arranged to save labor, most labor being saved in moving seed from storage and in cleaning seed. For mills using unusually large amounts, the data offered no specific explanations.

In all areas most mills used a total of 24 man-hours or less per day for each of the following operations: Moving seed from storage, cleaning seed, huller-separation, and baling linters (table 13). Linters baling was the only one of these operations for which big mills usually used more total man-hours per day than smaller ones did, but they still used less per ton of seed than smaller mills.

Large mills generally used more daily labor in the linter room than smaller ones, but man-hours per ton of seed decreased with increase in size of mill. As shown in figure 9, on the average, Valley mills used more labor per ton of seed in the linter room than mills in the other areas. Size of mill, however, explained only about 20 percent of the variation in labor used by Valley mills and even less than that by mills in other areas.

Much of the variation in linter-room labor per ton of seed may be accounted for by such factors as number of delinters per mill, tons of seed per delinter, and yield of linters per ton of seed.

The number of delinters varied from under 15 to more than 50 per mill (table 14). Mills of widely different sizes used the same number of machines. Thus, mills with capacities of 90 and 180 tons per day might use 30 delinters, processing 3 and 6 tons of seed per delinter per 24 hours, respectively.

The seed processed per delinter ranged from 2 to 8 tons, averaged about 4.5 tons (table 15). In the Southeast, mills with the largest number of delinters processed the most seed per delinter. However, in contrast to mills in other areas, few mills in the Southeast processed over 5 tons of seed per delinter.

The relatively low seed throughputs per delinter in the Southeast are explained partly by the fact that seed in this area generally has a higher linters' content than seed in other areas (table 7).

Table 13.--Proportion of cottonseed oil mills using specified amounts of labor in preparation for extracting oil, by area 1/

Mill operation and labor used per day	Percentage of total mills 2/			
	United States	Southeast	Valley	Southwest
	Percent	Percent	Percent	Percent
Moving seed from storage:				
Under 24 man-hours	29	30	14	41
24 man-hours	55	60	61	46
Over 24 man-hours	16	10	25	13
Cleaning seed:				
Under 24 man-hours	33	43	28	30
24 man-hours	58	50	58	63
Over 24 man-hours	9	7	14	7
Huller-separation:				
Under 24 man-hours	32	37	17	41
24 man-hours	55	53	58	55
Over 24 man-hours	13	10	25	4
Baling linters:				
Under 24 man-hours	6	13	0	7
24 man-hours	62	50	67	65
Over 24 man-hours	32	37	33	28

1/ Excludes labor for delinting.
2/ Based on reports of 112 mills--30, 36, and 46 in the Southeast, Valley, and Southwest areas, respectively.

The yield of linters per delinter, shown in table 16, depends on the amount of linters on the seed, the throughput per machine, and the number of linter saws (the mills were not questioned on the number of saws). The yield of linters per delinter for all mills varied from about 400 to over 1,300 pounds per day. More than 40 percent of the mills in the Southeast had daily yields exceeding 1,000 pounds per delinter, compared with about 25 and 29 percent of the mills in the Valley and Southwest, respectively.

Three-fourths of the mills produced 2 cuts of linters, whereas about 20 percent (mainly in the Valley and Southwest areas) produced 3 cuts or more, and 5 percent did not separate into grades but produced mill-run linters.

Man-hours used in the linter rooms ranged from 1 to over 5 per delinter per day (table 17). In the Southeast, only 8 percent of the mills used over 3.5 man-hours per delinter compared to 26 percent in the Valley. The man-hours used in the linter rooms were not necessarily related to the number of

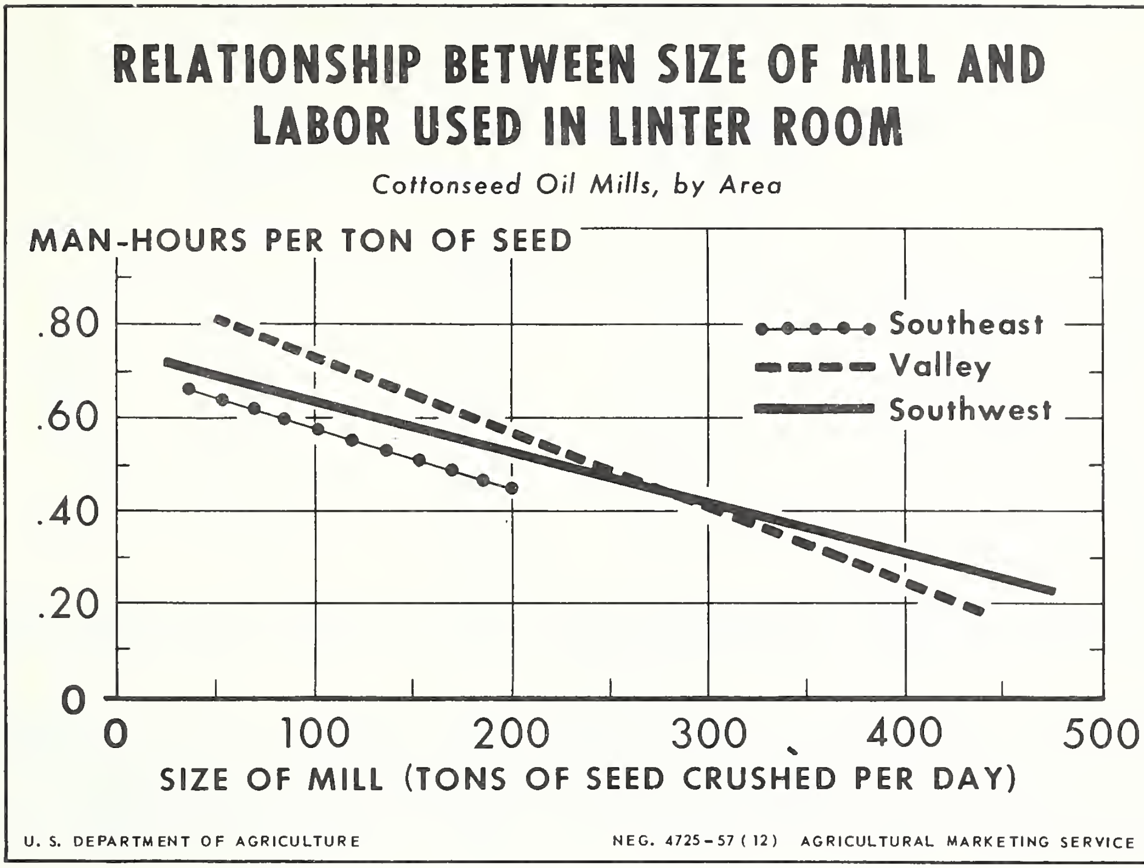

Figure 9

machines. In fact, mills using the same number of man-hours varied widely in number of delinters used. For example, 48 man-hours per day were used by mills having from 9 to 34 delinters in the Southwest, from 16 to 29 in the Southeast, and from 14 to 24 in the Valley.

Based on the man-hours used in the linter rooms and bale-press rooms, table 18 shows the estimated labor used and cost per bale of linters for mills in the different areas. Southeast mills used less labor to produce a bale of linters than mills of similar size in the other areas. However, the average labor used per bale of linters for all mills was lowest in the Southwest, where the average size of mill was much larger than in the Southeast.

Oil-Extraction Labor

It is well recognized that the hydraulic process is the highest user of labor and that most mills of this type are old. The oil-extraction departments of nearly 60 percent of all hydraulic mills in the sample were

Table 14.--Distribution of cottonseed oil mills by number of delinters, United States and areas, 1954-55 1/

Number of delinters	United States	Southeast	Valley	Southwest
	Percent	Percent	Percent	Percent
Total	100	100	100	100
Under 15	7	10	9	4
15 - 19	22	35	20	16
20 - 24	17	17	14	18
25 - 29	21	28	11	25
30 - 34	11	3	14	13
35 - 39	6	7	9	4
40 - 44	4	0	3	7
45 - 49	5	0	9	4
50 and over	7	0	11	9

1/ Based on a total of 109 mills--29, 35, and 45 located in the Southeast, Valley, and Southwest areas, respectively.

constructed before 1920--more than 35 years ago (table 19). Only one hydraulic mill had installed a new press since 1950. In contrast, with only 1 exception, the extraction departments of all screw-press mills (60) were built after 1940, and two-thirds of them after 1950. Of the 14 solvent-extraction mills reporting age, 10 had installed extraction departments or had been built since 1950.

Screw-press mills used less labor in the oil-extraction department than either the solvent-extraction or hydraulic mills. On the average, hydraulic mills used more than 3 times as much labor as screw-press mills and about $2\frac{1}{2}$ times as much as the solvent-extraction mills (fig. 10). Size of mill accounted for 41 percent of the variation in man-hours per ton used by screw-press mills, compared to 35 percent for the hydraulic mills, and 12 percent for the solvent-extraction type.

Screw-press mills were more consistent in their labor usage than the other types. More than one-half of the mills used 48 man-hours per day, even though their presses ranged from 2 to 6 per mill, and their throughputs per press ranged from 10 to 45 tons per day. Generally, screw-press mills with throughputs per press of 25 tons and under per day used less labor than mills with the same number of presses but higher throughputs. For example, three of the seven 6-press mills shown in table 20 had throughputs under 25 tons per press per day and used 48 man-hours per day. This compared with 60 man-hours used by three 6-press mills with throughputs over 25 tons per press per day.

More than one-half of the screw-press mills had throughputs per press exceeding 30 tons per day (table 21). More than one-fifth of them were crushing

Table 15.--Distribution of cottonseed oil mills and number of delinters per mill, by tons of seed processed per delinter, by area 1/

Tons of seed processed per delinter per day	United States: Percentage of total mills	United States: Delinters per mill	Southeast: Percentage of total mills	Southeast: Delinters per mill	Valley: Percentage of total mills	Valley: Delinters per mill	Southwest: Percentage of total mills	Southwest: Delinters per mill
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Total or average	100	29	100	22	100	31	100	31
2.0 - 2.9	6	19	10	19	0	---	7	20
3.0 - 3.9	22	26	17	21	26	26	22	29
4.0 - 4.9	36	30	56	22	29	35	31	35
5.0 - 5.9	29	30	17	26	39	31	29	32
6.0 - 6.9	6	30	0	---	6	27	9	31
7.0 - 7.9	1	15	0	---	0	---	2	15

1/ Based on 29, 35, and 45 mills located in the Southeast, Valley, and Southwest areas, respectively.

Table 16.--Distribution of cottonseed oil mills and man-hours used per delinter per day by linters produced per delinter, by area 1/

Linters produced per delinter per day (pounds) 2/	United States: Percentage of total mills	United States: Man-hours per delinter	Southeast: Percentage of total mills	Southeast: Man-hours per delinter	Valley: Percentage of total mills	Valley: Man-hours per delinter	Southwest: Percentage of total mills	Southwest: Man-hours per delinter
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Total or average	100	2.60	100	2.51	100	2.81	100	2.50
300 - 399	1	1.33	0	---	0	---	2	1.33
400 - 499	3	2.22	3	1.20	0	---	5	2.73
500 - 599	4	2.15	3	2.00	0	---	7	2.20
600 - 699	13	2.86	14	2.92	17	3.01	9	2.57
700 - 799	10	2.60	3	2.67	14	2.13	12	3.06
800 - 899	22	2.92	22	2.55	30	3.39	18	2.61
900 - 999	16	2.44	14	2.02	14	2.76	18	2.46
1,000 - 1,099	13	2.24	14	2.36	14	2.13	12	2.26
1,100 - 1,199	10	2.64	14	2.79	11	2.83	7	2.19
1,200 - 1,299	5	2.51	10	2.71	0	---	5	2.20
1,300 - 1,399	3	2.85	3	3.00	0	---	5	2.78

1/ Based on 29, 35, and 43 mills located in the Southeast, Valley, and Southwest areas respectively.
2/ Based on 1953-54 yields of linters per ton of seed processed.

Table 17.--Distribution of cottonseed oil mills and number of delinters, by daily man-hours used per delinter, by area, 1954-55 1/

Daily man-hours per delinter	United States: Percentage of total mills	United States: Delinters Per mill	United States: Delinters Range	Southeast: Percentage of total mills	Southeast: Delinters Per mill	Southeast: Delinters Range	Valley: Percentage of total mills	Valley: Delinters Per mill	Valley: Delinters Range	Southwest: Percentage of total mills	Southwest: Delinters Per mill	Southwest: Delinters Range
	Percent	Number	Number	Percent	Number	Number	Percent	Number	Number	Percent	Number	Number
1.0 - 1.4	5	34	18-48	0	0	--	5	35	21-48	7	33	18-48
1.5 - 1.9	10	39	13-96	15	24	13-29	9	45	37-51	10	49	28-96
2.0 - 2.4	24	31	12-65	22	20	12-29	20	39	24-55	29	31	15-65
2.5 - 2.9	22	29	15-80	33	26	15-38	17	35	18-80	19	28	17-39
3.0 - 3.4	23	25	12-82	22	17	12-20	23	21	12-44	24	33	21-82
3.5 - 3.9	4	24	17-27	0	0	--	3	25	--	7	23	17-27
4.0 - 4.4	4	24	15-30	4	15	--	9	27	22-30	0	0	--
4.5 - 4.9	4	22	16-29	4	25	--	9	22	16-29	0	0	--
5.0 - 5.4	4	18	9-29	0	0	--	5	23	18-29	4	13	9-16

1/ Based on reports of 104 mills--27, 35, and 42 located in the Southeast, Valley and Southwest areas, respectively.

Table 18.--Estimated labor and cost per bale of linters produced, by area and size of cottonseed oil mills

Area and size of mill (tons per day)	Mills reporting	Average size of mill	Delinters per mill	Labor used: Per delinter	Labor used: Per ton of seed	Linters yield per ton of seed 1/	Hourly wage rate	Labor used per bale of linters (600 lbs.) produced 2/	Labor cost per bale of linters 3/
	Number	Tons per day	Number	Man-hours	Man-hours	Pounds	Dollars	Man-hours	Dollars
Southeast	34	86	21	2.60	1.03	221	0.830	2.85	2.35
50 and under ...	8	36	15	2.47	1.31	217	.765	3.59	2.94
51 - 100	16	79	19	2.81	1.05	220	.812	2.95	2.36
101 - 150	8	125	27	2.33	.78	223	.885	2.12	1.87
151 - 200	2	188	37	2.60	.75	234	4/	1.93	4/
Valley	36	130	29	2.95	.91	188	.851	2.93	2.50
50 and under ...	2	40	13	2.80	1.32	178	.775	4.46	3.47
51 - 100	14	79	20	3.04	1.01	185	.829	3.32	2.73
101 - 150	10	135	29	3.63	.97	189	.888	3.09	2.69
151 - 200	5	196	40	2.41	.70	193	.878	2.17	1.91
201 - 250	5	237	49	1.94	.54	199	1.057	1.65	1.72
251 and over ...	4/								
Southwest	44	148	32	2.62	.86	189	.994	2.82	2.62
50 and under ...	2	35	14	3.33	1.75	164	.763	6.31	4.78
51 - 100	14	85	22	2.66	.98	179	.883	3.32	2.92
101 - 150	12	123	27	2.70	.82	199	.849	2.50	2.11
151 - 200	10	182	35	2.52	.68	187	1.048	2.29	2.24
201 - 250	2	235	42	1.86	.55	220	1.643	1.52	2.44
251 and over ...	4	376	73	2.55	.68	192	1.477	2.23	3.13

1/ Based on linters yields for 1953-54.
2/ Based on labor used in big month of 1954-55 in linter room and bale-press room.
3/ Based on straight-time hourly wage rates, 1954.
4/ Excluded from calculations because only 1 mill reported necessary data.

Table 19.--Age of oil-extraction departments, by type of cottonseed oil mill and area, 1954-55 1/

Type of mill and age of oil-extraction department	United States		Southeast		Valley		Southwest	
	Mills reporting	Percentage of total	Mills reporting	Percentage of total	Mills reporting	Percentage of total	Mills reporting	Percentage of total
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All types	113	100	35	100	37	100	41	100
5 years and under	51	45	11	31	14	38	26	64
6 - 15 years	31	27	7	20	11	30	13	32
16 - 25 years	4	4	2	6	2	5	0	0
26 - 35 years	4	4	3	9	0	0	1	2
Over 35 years	23	20	12	34	10	27	1	2
Hydraulic	39	100	19	100	15	100	5	100
5 years and under	1	2	0	0	0	0	1	20
6 - 15 years	8	21	3	16	3	20	2	40
16 - 25 years	4	10	2	10	2	13	0	0
26 - 35 years	3	8	2	10	0	0	1	20
Over 35 years	23	59	12	64	10	67	1	20
Screw press	60	100	14	100	13	100	33	100
5 years and under	40	66	9	64	8	62	23	70
6 - 15 years	19	32	4	29	5	38	10	30
16 - 25 years	0	0	0	0	0	0	0	0
26 - 35 years	1	2	1	7	0	0	0	0
Solvent	14	100	2	100	9	100	3	100
5 years and under	10	71	2	100	6	67	2	67
6 - 15 years	4	29	0	0	3	33	1	33

1/ Age of extraction departments for hydraulic and screw-press mills is, in some cases, year of installation of newest presses.

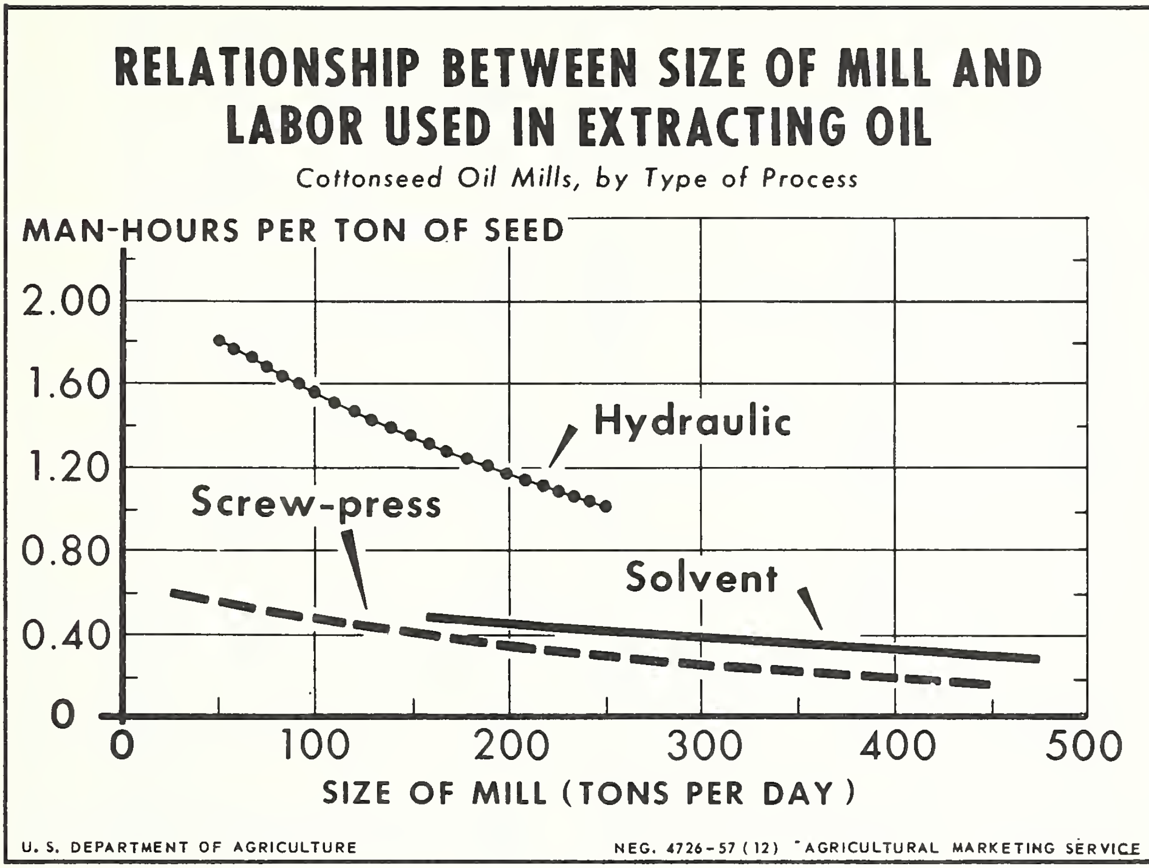

Figure 10

as much as 40 tons and over per press per day. Most hydraulic mills had throughputs under 10 tons per press.

Hydraulic mills with the same number of presses differed widely in their use of press-room labor, even though they processed about the same amount of seed per day per press. For example, labor used per day by six 12-press mills ranged from 144 to 222 man-hours (table 22). The throughputs per press, however, only ranged from 8 to 11 tons per day.

Solvent-extraction mills showed very little pattern in their extraction-room labor per day, with smaller mills quite often using more than larger ones. Labor was reported for 6 prepress-solvent and 6 direct-solvent mills. The prepress-solvent mills averaged 200 tons in size. They tended to use less extraction labor than the direct-solvents which averaged almost 300 tons. In terms of daily man-hours used, the average was 75 for the prepress type compared to 120 for the direct-solvent. Three prepress-solvent mills of 200 to 215 tons used an average of 80 man-hours per day, compared with an average of 108 man-hours by direct-solvent mills of the same sizes.

Table 20.--Labor used per day in oil-extraction department in screw-press cottonseed oil mills and tons of seed crushed per press per day, by area and number of presses

Number of presses per mill	Mills reporting	Labor used per day for extracting oil: Per mill	Labor used per day for extracting oil: Range	Seed crushed per press per day: Per mill	Seed crushed per press per day: Range	Mills reporting	Labor used per day for extracting oil: Per mill	Labor used per day for extracting oil: Range	Seed crushed per press per day: Per mill	Seed crushed per press per day: Range
	United States					Southeast				
	Number	Man-hours	Man-hours	Tons	Tons	Number	Man-hours	Man-hours	Tons	Tons
1 - 2 ...	17	38	24 - 48	36	19 - 45	6	36	24 - 48	28	19 - 38
3	10	43	24 - 72	33	15 - 42	2	36	24 - 48	39	37 - 42
4	13	50	24 - 72	32	25 - 50	2	48	---	32	29 - 35
5	5	62	48 - 112	35	23 - 56	0	---	---	---	---
6	7	57	48 - 72	23	10 - 33	1	48	---	10	---
7 - 16 ..	5	82	72 - 96	28	22 - 35	0	---	---	---	---
	Valley					Southwest				
	Number	Man-hours	Man-hours	Tons	Tons	Number	Man-hours	Man-hours	Tons	Tons
1 - 2 ...	4	36	24 - 48	36	30 - 45	7	41	24 - 48	42	25 - 45
3	1	72	---	25	---	7	41	24 - 48	29	15 - 40
4	5	53	48 - 64	32	25 - 38	6	48	24 - 72	33	25 - 50
5	1	56	---	23	---	4	64	48 - 112	38	26 - 56
6	1	48	---	20	---	5	60	48 - 72	27	15 - 33
7 - 16 ..	1	72	---	35	---	4	84	72 - 96	27	22 - 30

Table 21.--Distribution of hydraulic and screw-press cottonseed oil mills, by tons of seed crushed per press per day, by area

Type of mill and tons of seed crushed per press	United States: Mills reporting	United States: Percentage of total	Southeast: Mills reporting	Southeast: Percentage of total	Valley: Mills reporting	Valley: Percentage of total	Southwest: Mills reporting	Southwest: Percentage of total
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Hydraulic	31	100	15	100	12	100	4	100
6 - 7	2	6	0	0	2	17	0	0
8	10	32	6	41	4	33	0	0
9	8	26	2	13	4	33	2	50
10	4	13	3	20	0	0	1	25
11	4	13	2	13	2	17	0	0
12 - 13	3	10	2	13	0	0	1	25
Screw press	57	100	11	100	13	100	33	100
Under 20	4	7	2	18	0	0	2	6
20 - 24	5	9	1	9	2	15	2	6
25 - 29	15	26	2	18	2	15	11	34
30 - 34	8	14	1	9	2	15	5	15
35 - 39	13	23	4	37	5	40	4	12
40 - 44	7	12	1	9	2	15	4	12
45 - 49	3	5	0	0	0	0	3	9
50 and over	2	4	0	0	0	0	2	6

Table 22.--Labor used per day in oil-extraction departments in hydraulic cottonseed oil mills and tons of seed crushed per press per day, by area and number of presses

Number of presses per mill	Mills reporting	Labor used per day for extracting oil: Per mill	Labor used per day for extracting oil: Range	Seed crushed per press per day: Per mill	Seed crushed per press per day: Range	Mills reporting	Labor used per day for extracting oil: Per mill	Labor used per day for extracting oil: Range	Seed crushed per press per day: Per mill	Seed crushed per press per day: Range
	United States					Southeast				
	Number	Man-hours	Man-hours	Tons	Tons	Number	Man-hours	Man-hours	Tons	Tons
4 - 5 ...	2	72	48 - 96	12	12 - 13	1	96	---	13	---
6	3	112	96 - 120	10	8 - 11	1	96	---	11	---
7 - 8 ...	5	134	120 - 168	10	9 - 12	4	132	120 - 168	10	9 - 12
9	2	126	120 - 132	8	---	2	126	120 - 132	8	---
10	5	134	120 - 168	8	7 - 10	1	144	---	10	---
12	6	180	144 - 222	9	8 - 11	4	180	144 - 222	9	8 - 10
14 - 15..	3	155	120 - 176	8	6 - 9	1	168	---	8	---
16 - 32..	5	203	168 - 296	8	8 - 9	1	168	---	8	---
	Valley					Southwest				
	Number	Man-hours	Man-hours	Tons	Tons	Number	Man-hours	Man-hours	Tons	Tons
4 - 5 ...	0	---	---	---	---	1	48	---	12	---
6	2	120	---	10	8 - 11	0	---	---	---	---
7 - 8 ...	1	144	---	9	---	0	---	---	---	---
9	0	---	---	---	---	0	---	---	---	---
10	3	136	120 - 168	8	7 - 9	1	120	---	9	---
12	1	168	---	11	---	1	192	---	10	---
14 - 15..	2	148	120 - 176	8	6 - 9	0	---	---	---	---
16 - 32..	3	219	168 - 296	8	8 - 9	1	192	---	9	---

Meal Processing, Hull Storage and Loading, and Boilerroom

As shown in table 23, on the average, Southeast mills used more labor per ton of seed for meal processing, hull storage and loading, and boilerroom operation than mills in other areas. This is due partly to the fact that most mills in the Southeast are small.

Table 23.--Labor used per ton of seed for meal processing, hull storage and loading, and boilerroom, in cottonseed oil mills, by area and type of process

Area and type of mill	Mills reporting	Average size of mill	Man-hours per ton of seed			
			Total	Meal processing	Hull storage and loading	Boilerroom
	Number	Tons per day	Number	Number	Number	Number
Southeast	1/ 30	96	0.954	0.529	0.255	0.170
Hydraulic	16	94	.973	.518	.305	.150
Screw press ...	13	89	1.012	.594	.221	.197
Valley	35	147	.593	.362	.127	.104
Hydraulic	14	123	.718	.454	.162	.102
Screw press ...	13	117	.583	.370	.108	.105
Solvent	8	238	.487	.273	.109	.105
Southwest	42	150	.602	.480	.048	.074
Hydraulic	6	127	.652	.484	.042	.126
Screw press ...	33	143	.588	.468	.047	.073
Solvent	3	278	.632	.546	.057	.029

1/ Includes 1 solvent mill.

Only about 20 percent of the mills operated their meal rooms on a 24-hour basis (table 24). More than one-half of those were solvent mills. With minor exceptions only the larger hydraulic and screw-press mills (over 150 tons daily capacity) operated on such a basis. However, some mills that operated 1 shift of 12 hours or less used as much labor as others operating 24 hours.

Although the normal daily crushing capacity in the Southeast ranged from 50 to 150 tons, there was no relationship between size of mill and labor used per ton of meal processed (table 25). This was not true for mills in the Valley and Southwest. In the Valley, mills of 50 tons and less per day used 3.3 man-hours per ton of meal processed, which decreased to 0.9 man-hour for mills ranging in size from 101 to 150 tons per day. The decrease continued for larger mills. The same principle applied to mills in the Southwest.

Table 24.--Number of operating shifts per day in meal room and for hull storage and loading in cottonseed oil mills

Area and type of mill	Meal room 1/					Hull storage and loading						
	8-hour shifts per day			12-hour shifts per day		8-hour shifts per day				12-hour shifts per day		
	1	2	3	1	2	0	1	2	3	0	1	2
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
All areas	21	14	12	49	9	11	18	9	10	23	12	24
Hydraulic	2	3	5	19	5	1	4	3	3	6	3	16
Screw press	17	8	1	30	3	8	12	3	3	17	9	7
Solvent	2	3	6	0	1	2	2	3	4	0	0	1
Southeast	2	4	4	16	4	1	2	3	4	1	5	14
Hydraulic	0	2	2	9	3	0	1	1	2	0	2	10
Screw press	2	2	1	7	1	1	1	1	2	1	3	4
Solvent	0	0	1	0	0	0	0	1	0	0	0	0
Valley	10	4	7	12	0	3	7	6	6	5	2	6
Hydraulic	1	1	3	7	0	1	2	2	1	2	1	5
Screw press	7	1	0	5	0	2	3	2	1	3	1	1
Solvent	2	2	4	0	0	0	2	2	4	0	0	0
Southwest	9	6	1	21	5	7	9	0	0	17	5	4
Hydraulic	1	0	0	3	2	0	1	0	0	4	0	1
Screw press	8	5	0	18	2	5	8	0	0	13	5	2
Solvent	0	1	1	0	1	2	0	0	0	0	0	1

1/ Excludes 2 mills that produced slab cake in the Valley and therefore did not operate a meal room.

Table 25.--Estimated labor used in meal room and costs per ton of meal produced in different areas, by size of cottonseed oil mill 1/

Area and size of mill (tons per day)	Mills reporting	Production of meal per mill: Annual	Production of meal per mill: Per day	Labor used per ton of meal	Wage rate per hour in meal room	Labor cost per ton of meal	Sales of meal: Local	Sales of meal: Wholesale	Meal sold in form of--: Sacked	Bulk	Cracked or sized cake 2/	Pellets	Slab cake
	Number	Tons	Tons	Man-hours	Dollars	Dollars	Percent	Percent	Percent	Percent	Percent	Percent	Percent
United States	98	11,054	57	1.03	0.921	0.95	43	57	74	11	1	13	1
Southeast	29	5,038	38	1.22	.807	.98	47	53	92	6	0	1	1
50 and under ...	8	2,005	18	1.88	.759	1.43	67	33	98	2	0	0	0
51 - 100	13	5,075	39	1.04	.809	.84	41	59	91	6	0	0	3
101 - 150	8	8,010	56	1.22	.829	1.01	47	53	90	8	0	2	0
Valley	30	11,161	58	.90	.858	.77	28	72	79	17	1	2	1
50 and under ...	2	2,716	18	3.33	.750	2.50	74	26	97	0	1	0	2
51 - 100	13	6,067	37	1.15	.789	.91	63	37	83	10	1	2	4
101 - 150	8	11,237	62	.91	.904	.82	28	72	81	16	2	1	0
151 - 200	3	18,263	90	.71	.795	.56	6	94	71	20	0	9	0
201 - 250	4	26,462	110	..50	1.047	.53	10	90	77	21	1	1	0
Southwest	39	15,447	72	1.04	1.007	1.05	51	49	66	9	2	23	0
50 and under ...	2	2,347	15	2.40	.750	1.80	100	0	48	0	0	52	0
51 - 100	13	6,267	41	1.38	.861	1.19	83	17	60	0	3	37	0
101 - 150	9	13,209	63	1.15	.827	.96	44	56	66	1	4	29	0
151 - 200	9	17,080	85	1.03	1.054	1.08	35	65	77	3	0	20	0
201 - 250	2	20,771	106	.57	1.603	.91	59	41	60	23	9	8	0
251 - 500	4	50,533	171	.77	1.266	.98	52	48	63	20	0	17	0

1/ Mills producing mainly slab cake are omitted as they use no labor in meal room.
2/ Flakes included with cracked cake.

There appeared to be no relationship between form of meal produced (sacked, bulk, etc.) and the amount of labor used per ton of meal.

In none of the cotton-producing regions was there a relationship between size of mill and amount of labor used for storing and loading hulls. However, mills in the Southeast used nearly twice as much labor as those in the Valley and more than five times as much as those in the Southwest (table 23). The exceptionally small amount of labor used for storing and loading hulls by Southwest mills is due in great measure to the fact that they sold most of the hulls locally, and the customer generally loaded the hulls he purchased. Nearly 60 percent of the mills in this region reported that they used no labor for storing and loading hulls (table 24). Hulls sold locally by the mills in the three areas represented the following portions of total sales of hulls: .

	Percent
Southeast	60
Valley	65
Southwest	90

Boilerroom labor per ton of seed averaged highest for mills in the Southeast and lowest for those in the Southwest (table 23) This difference is explained partly by the fact that the Southeast had a much smaller percentage of mills with automatic boilers than the other areas (table 26).

There was little relationship between size of mill and man-hours per ton of seed for "all other operations"--that is, maintenance, yard and cleanup, and miscellaneous. However, comparison of mills by type show hydraulic mills to be the highest users (table 27). Man-hours per ton used by screw-press mills was much lower than that used by the other 2 types, mainly because labor used for maintenance was much lower. In many mills maintenance duties were performed by the superintendent and therefore the averages for maintenance labor are a little low. Hydraulic mills averaging 111 tons per day used 0.23 man-hour per ton for maintenance compared with 0.14 man-hour for screw-press mills averaging 125 tons in size, and 0.30 for solvent mills averaging 245 tons.

Superintendents and Laboratory Personnel

Superintendents and laboratory personnel were not included in the totals for normal daily labor. The number of superintendents per mill by size of mill is shown in table 28. Solvent mills used about 6 superintendents per mill; screw-press mills with capacities of more than 200 tons per day in the Southwest ranked highest, averaging over 6 per mill.

About 25 percent of the mills reported laboratory personnel. Seven of these mills were in the Southeast, 11 in the Valley, and 13 in the Southwest. Nine of the 15 solvent mills reported an average of over 3 laboratory workers per mill.

Table 26.--Number of cottonseed oil mills with automatic boilers and specified man-hours used per day in boilerrooms, by area and type of mill

Area and type of mill	Mills reporting	Mills with automatic boilers	Mills reporting labor used per day: Under 24 man-hours	24 man-hours	Over 24 man-hours
	Number	Number	Number	Number	Number
United States ...	107	45	12	40	10
Hydraulic	36	15	4	14	3
Screw press ...	59	27	6	22	4
Solvent	12	3	2	4	3
Southeast	30	10	4	12	4
Hydraulic	16	6	3	5	2
Screw press ...	13	4	1	7	1
Solvent	1	0	0	0	1
Valley	35	16	3	11	5
Hydraulic	14	8	0	5	1
Screw press ...	13	7	1	3	2
Solvent	8	1	2	3	2
Southwest	42	19	5	17	1
Hydraulic	6	1	1	4	0
Screw press ...	33	16	4	12	1
Solvent	3	2	0	1	0

Dormant-Season Labor

Labor kept on payrolls by mills during the dormant season ranged from less than 10 percent to 100 percent of their normal daily labor. More than one-half of the mills kept over one-third of their normal daily labor force, and about 10 percent kept their total daily force on their payrolls during their dormant seasons. In order to save on expense of recruiting new labor, mills which closed down for relatively short periods tended to keep a higher percentage of their normal labor on their payrolls during their dormant periods (fig. 11).

Wage Rates

Straight-time hourly wages were reported by the mills for the "big month" of 1954. Since then the minimum wage applicable to cottonseed oil mills has increased from $0.75 to $1 per hour. In 1954, 66 percent of the workers received wages less than $1 an hour (table 29). Highest wages were paid workers in California, Arizona, and Tennessee.

Table 27.--Labor used in cottonseed oil mills per ton of seed for yard and cleanup, maintenance, and miscellaneous operations, by type of process and area

Type of mill and area	Mills reporting	Average size of mill	Man-hours per ton			
			Total	Yard and cleanup	Mainte- nance	Miscel- laneous
	Number	Tons per day	Number	Number	Number	Number
Hydraulic	36	111	0.650	0.252	0.231	0.167
Southeast	16	94	.624	.253	.212	.159
Valley	14	123	.740	.259	.259	.222
Southwest	6	127	.511	.232	.216	.063
Screw-press	59	125	.396	.174	.137	.085
Southeast	13	89	.480	.245	.152	.083
Valley	13	117	.465	.205	.113	.147
Southwest	33	143	.336	.133	.141	.062
Solvent-extraction..	12	245	.504	.138	.303	.063
Valley 1/	9	234	.535	.153	.310	.072
Southwest	3	278	.412	.091	.283	.038

1/ Includes 1 mill located in the Southeast.

Mills of more than 200 tons per day paid, on the average, the highest wages for their types in each area (table 30). Screw-press mills generally paid the highest wages; however, much of this difference was due to their location rather than type of process. Mills operating on 8-hour shifts paid higher hourly wages, on the average, than those operating on 12-hour shifts. Only a few mills on 12-hour shifts reported paying overtime rates for work in excess of 8 hours per day.

For the individual mill operations, the highest wages were paid generally to maintenance workers. "Lead" men (worker-supervisors) in the linter rooms and oil-extraction departments generally received higher wages than the other workers in those departments.

Labor Cost

The amount of labor used on nontypical operating days varies widely and, being affected by conditions outside the mill, is less subject to control by the operator than that used for typical daily operations. For this reason the cost for labor used on nontypical operating days (during peak-season and down-season, and for intermittent crushings) was not considered in this report. Therefore the costs per ton of seed described below are those incurred for seed

Table 28.--Number of cottonseed oil mills reporting superintendents and number of superintendents per mill, by type and size of mill and area

Type of mill and area	Total		100 tons and under		101 to 200 tons		201 tons and over	
	Mills reporting	Per mill	Mills reporting	Per mill	Mills reporting	Per mill	Mills reporting	Per mill
	Number	Number	Number	Number	Number	Number	Number	Number
Hydraulic 1/	48	2.9	29	2.2	17	3.8	2	5.5
Southeast	21	2.5	16	2.3	5	3.2	---	---
Valley	17	3.6	10	2.2	5	5.6	2	5.5
Southwest	10	2.7	3	2.0	7	3.0	---	---
Screw press	60	3.4	29	2.9	25	3.3	6	6.1
Southeast	14	3.0	9	3.1	5	3.0	---	---
Valley	13	3.5	6	3.3	6	3.3	1	5.0
Southwest	33	3.5	14	2.5	14	3.4	5	6.4
Solvent extraction	15	5.5	---	---	8	5.3	7	5.9
Valley 2/	11	5.8	---	---	6	5.7	5	6.0
Southwest	4	4.8	---	---	2	4.0	2	5.5

1/ Mills that only delint and hull seed are included.
2/ Includes 2 mills in the Southeast.

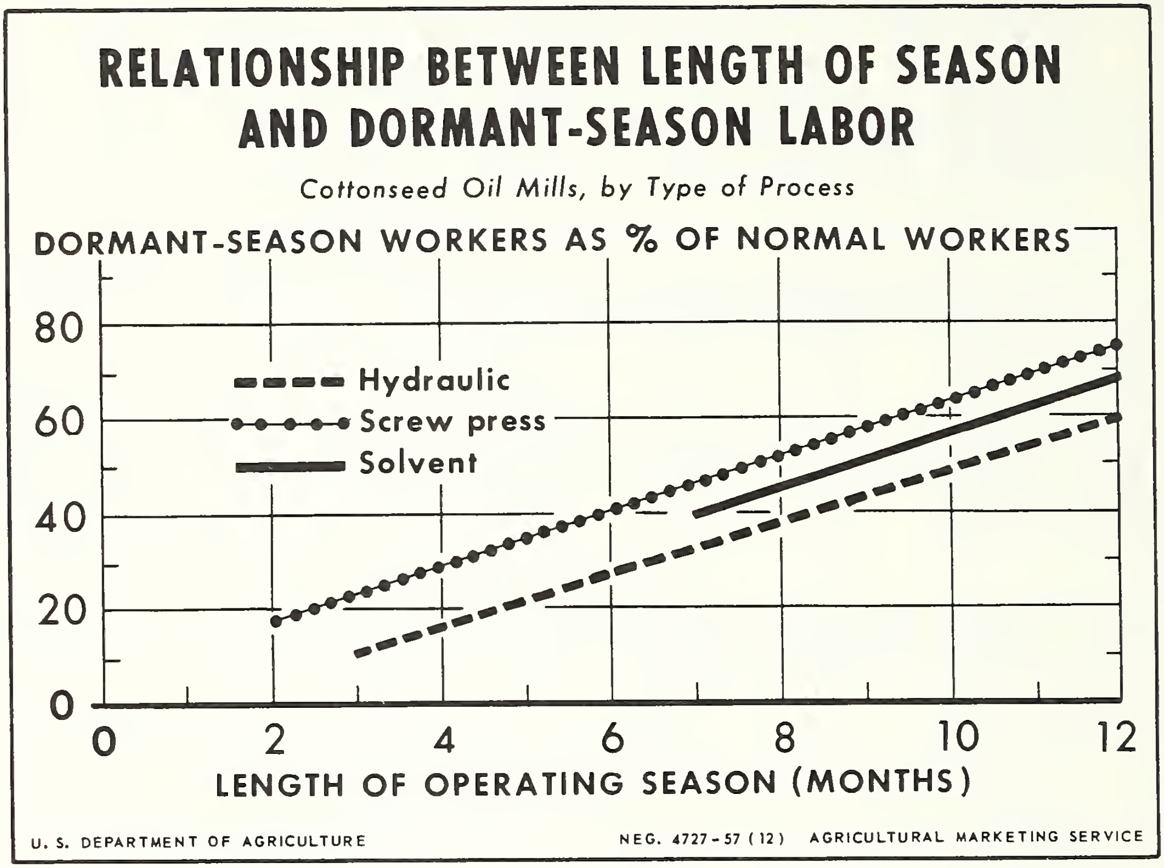

Figure 11

processed on any typical operating day and do not represent either man-hours or labor costs per ton of seed for the whole operating season.

On the average, labor cost per ton of seed for a typical operating day was highest for the hydraulic mills ($3.96) and lowest for the solvent-extraction mills ($2.67), as shown in table 31. Some of this difference is due to the fact that the solvent mills were more than twice as large as the hydraulic mills and almost twice as large as the screw-press mills.

Total wages per ton of seed include payments for normal daily labor and for peak- and dormant-season workers, overtime, and vacations, as reported for the 1953-54 season. In several cases, they also include bonuses and superintendents' salaries. Because some mills excluded these last two items, the averages are not precisely comparable.

Normal daily labor cost per ton of seed was about 68 percent of total wages for hydraulic mills, compared with 60 percent for solvent mills and 56 percent for screw-press mills.

Table 29.--Distribution of workers in cottonseed oil mills, by hourly wages paid, by area and State, 1954 1/

Area and State	Total workers 2/	Average hourly wage rate	Percentage of workers receiving straight-time hourly wage rates of--												
			$0.750 to .799	$0.800 to .849	$0.850 to .899	$0.900 to .949	$0.950 to .999	$1.000 to 1.099	$1.100 to 1.199	$1.200 to 1.299	$1.300 to 1.399	$1.400 to 1.499	$1.500 to 1.699	$1.700 to 1.899	$1.900 to 2.099
	No.	Dol.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
United States	4,804	0.981	22.2	15.9	11.1	9.4	7.8	11.2	6.6	3.2	3.5	2.2	1.8	4.0	1.1
Southeast	1,179	.869	31.3	19.0	15.9	15.8	7.6	3.2	2.8	.8	3.5	---	.1	---	---
Alabama	193	.890	12.4	6.7	17.6	51.9	7.8	3.6	---	---	---	---	---	---	---
Georgia	388	.911	15.5	29.2	17.8	5.7	13.7	3.1	5.9	.5	8.3	---	.3	---	---
North Carolina	375	.862	34.9	19.5	14.9	15.7	5.1	3.5	1.9	2.1	2.4	---	---	---	---
South Carolina	223	.789	69.1	10.8	12.6	2.2	1.3	2.7	1.3	---	---	---	---	---	---
Valley	1,879	.954	22.4	18.5	5.3	4.8	8.0	21.4	8.5	6.6	1.4	.2	2.9	---	---
Arkansas and Missouri ..	598	.952	9.2	22.4	3.2	3.2	14.7	40.9	3.5	.5	2.2	.2	---	---	---
Louisiana	224	.827	30.4	43.8	15.2	7.1	---	---	.4	3.1	---	---	---	---	---
Mississippi	534	.861	46.4	12.7	7.7	9.2	7.1	9.6	2.8	4.5	---	---	---	---	---
Tennessee	523	1.104	9.6	9.2	1.0	1.3	4.8	20.3	23.2	17.0	2.7	.6	10.3	---	---
Southwest	1,746	1.087	15.6	11.1	14.2	10.0	7.6	5.5	7.2	1.3	5.6	6.0	1.7	11.1	3.1
Arizona	192	1.401	---	---	---	---	---	---	---	---	49.0	40.1	10.9	---	---
California	274	1.746	---	---	---	---	---	---	---	4.7	---	3.3	2.6	70.1	19.3
Oklahoma	177	.882	2.8	31.2	22.0	30.5	9.0	4.5	---	---	---	---	---	---	---
Texas and New Mexico ...	1,103	.902	24.3	12.6	18.9	11.0	10.6	8.0	11.4	.9	.4	1.6	.2	---	.1

1/ Excludes temporary workers employed to unload, sample, sterilize, and store seed.
2/ Excludes 209 workers employed by 5 mills which did not report wage rates.

Table 30.--Average straight-time hourly wages for different types of cottonseed oil mills, by daily operating shifts, area, and size of mill 1/

Area and size of mill (tons of seed crushed per day)	All mills		Hydraulic 2/		Screw press		Solvent	
	Mills reporting	Wage rate	Mills reporting	Wage rate	Mills reporting	Wage rate	Mills reporting	Wage rate
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
All shifts								
Southeast	34	0.836	20	0.829	13	0.820	3/ 1	---
100 and under	24	.806	15	.810	9	.798	---	---
101 - 200	10	.907	5	.883	4	.870	---	---
201 and over	---	---	---	---	---	---	---	---
Valley	37	.899	17	.851	13	.916	7	0.982
100 and under	16	.819	10	.799	6	.852	---	---
101 - 200	15	.896	5	.877	6	.931	4	.867
201 and over	6	1.116	2	1.045	1	1.203	3	1.135
Southwest	47	.994	10	.848	33	1.023	4	1.124
100 and under	17	.867	3	.810	14	.879	---	---
101 - 200	23	.955	7	.864	14	.948	2	1.322
201 and over	7	1.433	---	---	5	1.635	2	.926
Three 8-hour shifts								
Southeast	10	0.927	4	0.885	5	0.911	3/ 1	---
100 and under	4	.860	1	.817	3	.874	---	---
101 - 200	6	.973	3	.908	2	.966	---	---
Valley	21	.982	6	.975	8	.987	7	.982
100 and under	4	.905	1	.910	3	.903	---	---
101 - 200	11	.937	3	.950	4	.996	4	.867
201 and over	6	1.116	2	1.045	1	1.203	3	1.135
Southwest	17	1.279	1	1.192	13	1.297	3	1.228
100 and under	4	1.018	---		4	1.018	---	---
101 - 200	6	1.273	1	1.192	4	1.152	1	1.834
201 and over	7	1.433		---	5	1.635	2	.926
Two 12-hour shifts 4/								
Southeast	24	0.810	16	0.814	8	0.764	---	---
100 and under	20	.795	14	.810	6	.761	---	---
101 - 200	4	.884	2	.846	2	.774	---	---
Valley	16	.789	11	.784	5	.801		
100 and under	12	.791	9	.787	3	.801	---	---
101 - 200	4	.784	2	.768	2	.800	---	---
Southwest	30	.883	9	.810	20	.845	1	.810
100 and under	13	.820	3	.810	10	.823	---	---
101 - 200	17	.843	6	.810	10	.866	1	.810

1/ Excluding overtime.
2/ Includes also 5 mills that only delint and hull cottonseed.
3/ Included in total for Southeast.
4/ Includes also 6 mills operating for 12 hours and less per day.

Table 31.--Labor cost for daily normal labor and total wages per ton of seed, by type of cottonseed oil mill, area, and size of mill

Type of mill, area, and size (tons per day)	Mills reporting	Size of crush per mill: Daily	Size of crush per mill: Annual	Labor cost per ton for a typical (normal) operating day 1/	Total wages per ton 2/	Daily normal labor cost as percentage of total wages
	Number	Tons	Tons	Dollars	Dollars	Percent
Hydraulic:						
All areas	32	112	19,100	3.96	5.86	68
100 and under	18	77	10,700	4.25	6.09	70
101 - 200	12	143	26,100	3.66	5.71	64
201 and over	2	237	52,300	3.10	4.62	67
Southeast	15	95	12,800	4.06	6.23	63
100 and under	10	81	10,900	4.12	6.54	63
101 - 200	5	123	16,600	3.93	5.61	70
Valley	12	121	24,300	4.06	5.39	75
100 and under	7	72	10,600	4.62	5.71	81
101 - 200	3	160	37,600	3.40	5.14	66
201 and over	2	237	52,300	3.10	4.62	67
Southwest	5	140	25,600	3.40	5.87	58
100 and under	1	85	10,300	2.94	4.28	69
101 - 200	4	153	29,500	3.52	6.27	58
Screw press:						
All areas	47	125	26,700	2.94	5.26	56
100 and under	22	75	12,000	3.29	5.82	57
101 - 200	20	141	28,200	2.54	4.72	54
201 and over	5	290	80,100	2.98	4.13	72
Southeast	7	74	10,800	3.14	5.20	60
100 and under	5	59	7,300	3.44	5.30	65
101 - 200	2	113	19,400	2.37	4.97	48
Valley	3/12	122	24,400	2.98	5.44	55
100 and under	5	86	16,700	3.10	4.79	65
101 - 200	6	132	24,100	3.00	6.33	47
Southwest	28	144	32,000	2.87	5.19	55
100 and under	12	80	12,600	3.31	6.46	51
101 - 200	12	150	31,800	2.34	3.87	60
201 and over	4	318	89,700	3.16	5.36	59
Solvent extraction:						
All areas	11	244	58,500	2.67	4.40	60
101 - 200	7	191	39,900	2.59	4.51	57
201 and over	4	336	91,200	2.82	4.20	67
Valley and Southeast	8	231	56,100	2.66	4.34	61
Southwest	3	278	65,000	2.71	4.56	59
Prepress-solvent	5	191	43,200	2.48	4.52	55
Direct-solvent	6	288	71,300	2.84	4.29	66

1/ Based on straight-time hourly wages, 1954.
2/ Reported for 1953-54.
3/ Includes 1 mill of over 200 tons per day.

Because of the different mill practices regarding peak- and dormant-season labor, overtime pay, etc., there was not much relationship between size of mill and total wages per ton of seed.

The cost of down-time per day also accounts for a part of the difference in total wages and normal daily labor costs. As used in the industry, "down-time" is the time lost from interruptions of mill operations, such as machinery breakdowns. Down-time per day (table 32 and fig. 12) was estimated from the normal daily capacity reported and the average tons processed per day during the 1954 calendar year.

Table 32.--Average down-time per 24-hour operating day, by type of cottonseed oil mill and area, 1954

Type of mill and area	Mills reporting	Average size of mill	Down-time per day: Average	Down-time per day: Highest
	Number	Tons per day 1/	Hours	Hours
Total	87	129	1.6	6.3
Southeast	23	86	1.8	5.5
Valley	26	135	1.2	6.3
Southwest	38	152	1.8	5.3
Hydraulic	31	104	1.7	6.3
Southeast	15	90	1.6	5.4
Valley	11	106	1.7	6.3
Southwest	5	140	2.1	5.2
Screw press	48	129	1.5	5.5
Southeast	8	79	2.0	5.5
Valley	10	133	.4	1.8
Southwest	30	141	1.7	5.3
Solvent	8	231	1.9	4.4
Valley	5	202	1.5	3.7
Southwest	3	278	2.5	4.4

1/ Seed crushed per day.

Some mills have regular shut-down periods for repairs so that once the mill starts, little time is lost during the day because of machinery breakdowns. Nevertheless, breakdowns will sometimes occur. Also, conditions over which the operator has no control, such as the quality of seed being processed, can slow down the amount of seed processed. Although not technically causing "down-time," this similarly increases labor and power cost per ton of seed processed.

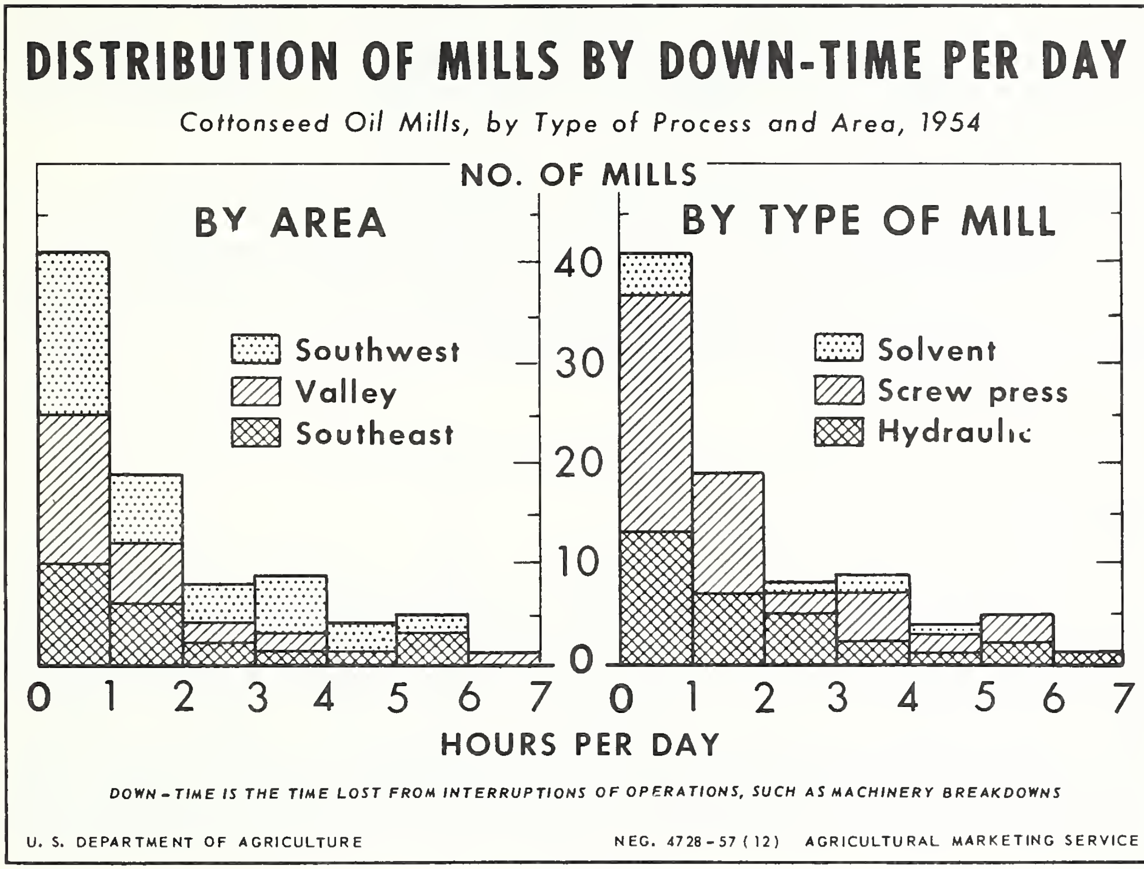

Figure 12

Screw-press mills in the Valley area averaged the lowest down-time per day, 0.4 hour, and also had the least variation, whereas solvent-extraction mills in the Southwest had the highest average of 2.5 hours per day.

Power and Fuel

Mills reported their consumption and costs of electric power by months for the calendar year 1954 and January 1955. They also reported the amount and cost of fuel used on a monthly basis for the same period.

Mills generating their own power by use of steam engines were not often able to separate the amount of steam needed for driving the mill and the amount needed for cooking cottonseed meats (or for desolventizing oil and meal in solvent-extraction mills). Many of the mills that processed more than one type of oilseed were not able to separate the amount of power and fuel used for processing each type of seed. Also, most operators of mills that combined feed

plants, cotton gins, oil refineries, or ice plants with cottonseed operations were not able to separate the power and fuel requirements of cottonseed processing from the requirements of their other activities. Some mills did not maintain power and fuel records. For these reasons the number of mills included in this analysis of power and fuel utilization is considerably smaller than the total number in the sample. Of the 123 mills in the sample, data from 55 permitted analysis of their power utilization.

About 25 percent of the sample mills were only partly electrified, steam power being used to drive a considerable portion of the mill (table 33). Therefore, the utilization and costs of power and fuel are considered in 3 parts: (1) Power utilization and costs of electric-powered mills, (2) fuel utilization and costs of electric-powered mills, and (3) power and fuel costs combined for electric and steam-powered mills.

Power for Electric-Powered Mills

Utilization

Differences in the power requirements of mills are due partly to differences in the type and amount of machinery used (including the operating rate or throughput per machine) and the form of products produced. For example, a mill storing a large quantity of seed needs more cooling fans than one storing a smaller quantity, and a mill producing mill-run linters uses less power than one producing first- and second-cut linters. Likewise, a hydraulic mill producing slab cake uses less power for meal processing than one producing bulk meal, and even still less than one producing pellets. In areas of wet seed, cooling fans in seed houses may use almost as much power at times as the rest of the mill.

As shown in table 34, power usage ranged from about 80 to 150 kilowatt-hours per ton of seed for hydraulic mills, from 100 to 190 for screw-press mills, and from 80 to 120 for solvent-extraction mills. Screw-press mills averaged 135 kilowatt-hours per ton of seed compared with 110 by hydraulic mills and 105 by solvent-extraction mills.

Although power usage depends on many factors, as indicated before, kilowatt-hours per ton of seed tended to decline as the size of mill increased. The chief reason for this is that certain pieces of equipment, such as seed unloaders and hull beaters, use about the same power regardless of the size of mill. Figure 13 shows the estimated relationship between kilowatt-hours per ton of seed and size of daily crush for the different types of mills.

Although screw-press mills used the most power and solvent-extraction mills the least, some hydraulic and solvent-extraction mills used as much as screw-press mills of similar size in the same general area or more. This could not be explained by differences in labor-saving machinery because the labor used in the preparation departments of these particular hydraulic and solvent-extraction mills was practically the same as for the screw-press mills.

Table 33.--Distribution of cottonseed oil mills producing power, by type of mill and by area and State

Area and State	Total mills in sample	Mills producing power: Total	Hydraulic	Screw press	Solvent	Other 1/
	Number	Number	Number	Number	Number	Number
United States ...	123	32	15	10	3	4
Southeast	37	7	6	0	1	---
Alabama	6	2	1	0	1	---
Georgia	9	2	2	0	0	---
North Carolina	11	2	2	0	---	---
South Carolina	11	1	1	0	---	---
Valley	39	9	6	0	2	1
Arkansas	10	1	1	0	0	---
Louisiana	6	3	3	0	0	---
Mississippi	13	5	2	0	2	1
Missouri	1	0	---	0	---	---
Tennessee	9	0	---	0	0	---
Southwest	47	16	3	10	0	3
Arizona	3	0	---	0	---	---
California	5	0	---	0	0	---
New Mexico	1	0	---	0	---	---
Oklahoma	7	5	---	5	---	---
Texas	31	11	3	5	0	3

1/ Mills that only delint and hull cottonseed and send meats to other mills for crushing.

Hydraulic and screw-press mills in the Southeast used, on the average, more electric power per ton of seed than those in the Valley area (fig. 14).

Costs

Since power costs per ton of seed depend on the cost per kilowatt-hour, as well as the kilowatt-hours used per ton of seed, big mills had a power cost advantage over smaller ones. This is true because the cost per kilowatt-hour decreases generally with the total amount purchased per month (fig. 15).

Southeast mills, on the average, paid the highest cost per kilowatt-hour, and Southwest mills the lowest. However, as shown in figure 16, a large number of Valley mills paid the lowest costs per kilowatt-hour. These were mainly mills located in areas serviced by TVA power.

Table 34.--Distribution of cottonseed oil mills by electric power consumed per ton of seed, by type of process and area

Kilowatt-hours consumed	Hydraulic				Screw-press				Solvent
	Total	South-east	Valley	South-west	Total	South-east	Valley	South-west	
	No.	No.	No.	No.	No.	No.	No.	No.	No.
Total	18	9	8	1	30	6	7	17	7
81 - 90	2	---	2	---	---	---	---	---	1
91 - 100	5	---	4	1	---	---	---	---	2
101 - 110	---	---	---	---	3	---	---	3	2
111 - 120	7	6	1	---	4	---	---	4	2
121 - 130	1	1	---	---	9	2	3	4	---
131 - 140	2	1	1	---	6	---	2	4	---
141 - 150	1	1	---	---	4	1	2	1	---
151 - 160	---	---	---	---	1	1	---	---	---
161 - 170	---	---	---	---	2	1	---	1	---
171 - 180	---	---	---	---	---	---	---	---	---
181 - 190	---	---	---	---	1	1	---	---	---

The average cost per kilowatt-hour varied widely. Some mills that used relatively large amounts of power per ton of seed had lower power costs per ton than other mills of the same size and type that used less power per ton but paid a higher price per kilowatt-hour. However, in general, the relationship between size of mill and cost of power is about the same as the relationship between size of mill and usage of power (fig. 14).

Fuel for Electric-Powered Mills

Utilization

For completely electrified mills, the amount of fuel used for processing seed depends on the steam requirements for cooking meats in hydraulic and screw-press mills, and desolventizing oil and meal in the solvent-extraction mills. Steam is also used in sterilizing seed and pelleting meal. The amount used also depends on the type of fuel, boiler efficiency, and the efficiency of overall heat utilization in the mill.

The mills studied used gas, coal, and oil, as shown in table 35 (one mill reported using wood). Gas was used by 64 percent of the mills, coal by 27, and oil by 9 percent. All mills in the Southwest, except one, used gas. All three fuels were used in the Southeast and Valley areas, but coal was used most in the Southeast and gas in the Valley area. Some mills, although using mainly gas or coal, kept inventories of oil on hand as a stand-by fuel.

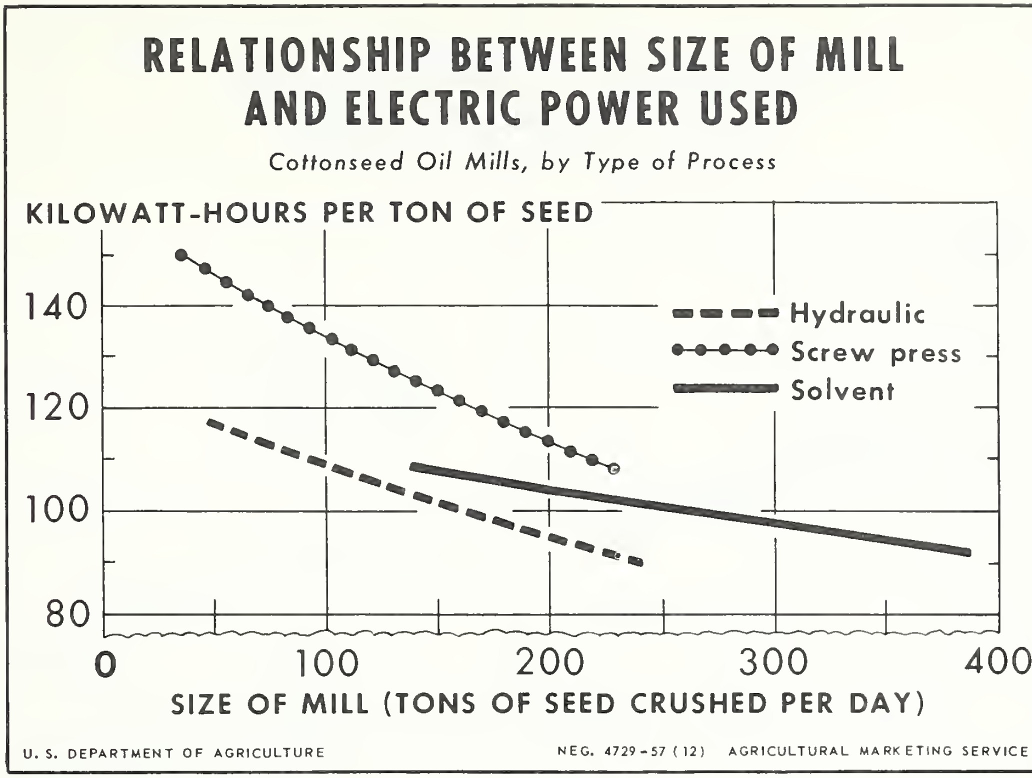

Figure 13

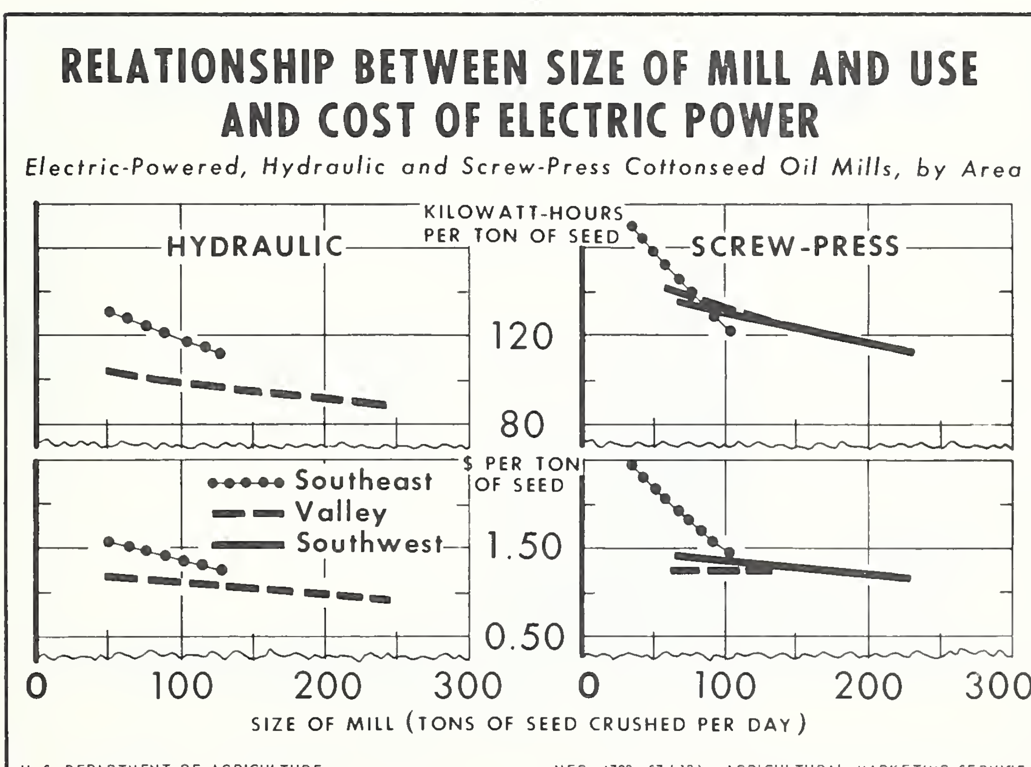

Figure 14

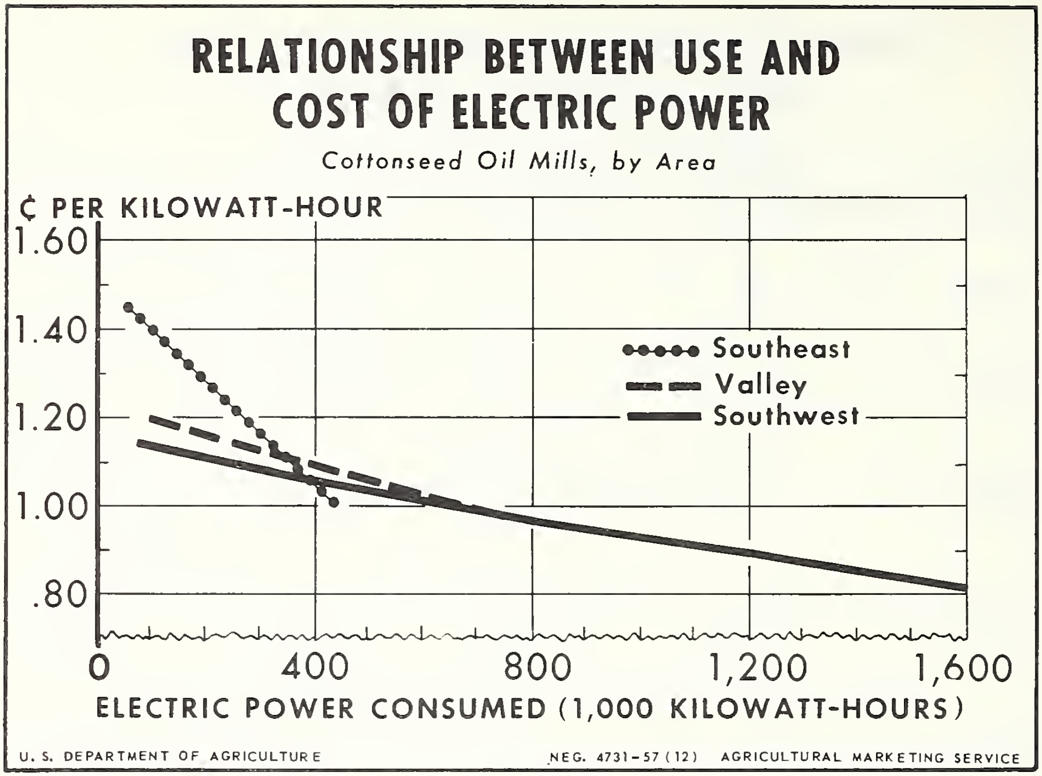

Figure 15

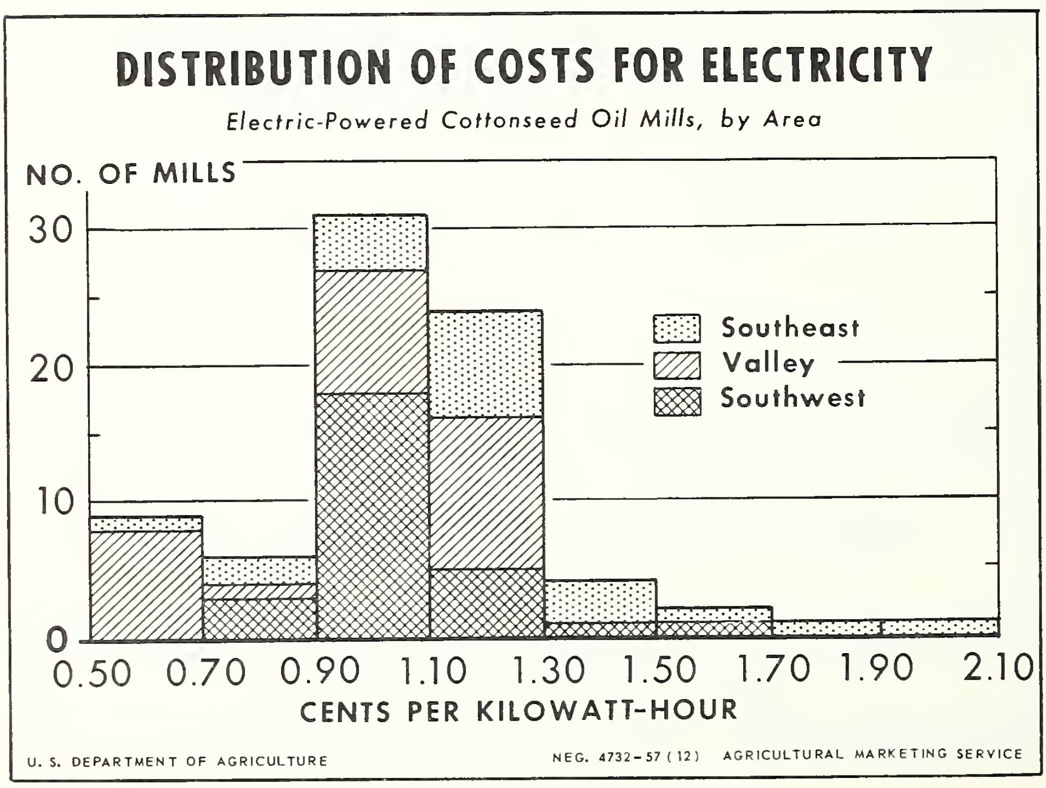

Figure 16

Table 35.--Type of fuel used for processing seed and producing power in cottonseed oil mills, by area and type of process

Area and type of mill	Mills using fuel for all purposes				Mills using fuel only for processing				Mills using fuel for producing power			
	Total	Coal	Oil	Gas	Total	Coal	Oil	Gas	Total	Coal	Oil	Gas
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
United States	118	32	11	75	86	26	10	50	32	6	1	25
Hydraulic 1/	46	16	6	24	27	11	5	11	19	5	1	13
Screw press	57	15	3	39	47	15	3	29	10	---	---	10
Solvent extraction	15	1	2	12	12	---	2	10	3	1	---	2
Southeast	37	27	6	4	30	21	6	3	7	6	---	1
Hydraulic	21	15	3	3	15	10	3	2	6	5	---	1
Screw press	14	2/11	2	1	14	2/11	2	1	---	---	---	---
Solvent extraction	2	1	1	---	1	---	1	---	1	1	---	---
Valley	3/35	5	4	26	26	5	3	18	9	---	1	8
Hydraulic 1/	16	1	3	12	9	1	2	6	7	---	1	6
Screw press	10	4	---	6	10	4	---	6	---	---	---	---
Solvent extraction	9	---	1	8	7	---	1	6	2	---	---	2
Southwest	46	---	1	45	30	---	1	29	16	---	---	16
Hydraulic 1/	9	---	---	9	3	---	---	3	6	---	---	6
Screw press	33	---	1	32	23	---	1	22	10	---	---	10
Solvent extraction	4	---	---	4	4	---	---	4	---	---	---	---

1/ Four mills that delint and hull only are included but are classified as hydraulic mills, 1 located in Valley and 3 in Southwest; all use fuel for producing power.
2/ Includes one mill using wood.
3/ Omits one mill that purchases steam from outside source.

Heating values of the different fuels vary, within each fuel, as well as between them. Information on the specific heating values of fuels used by mills was not available. Therefore, the average heating values used for each fuel were: 1,000 B. t. u. (British thermal units) per cubic foot of natural gas; 150,000 B. t. u. per gallon of heavy industrial oil; and 13,000 B. t. u. per pound of industrial coal.

Steam usage was then estimated by assuming that 1 pound of steam (125 pounds per square inch) was equivalent to 868.2 B. t. u., and that boilers operated at 80 percent efficiency. Although boilers in many mills are not this efficient, this figure was used because it is the percentage guaranteed by most manufacturers.

The wide variation in steam usage per ton of seed by mills of the same type, as shown in table 36, indicates that either the boiler efficiency or the overall heat utilization could be improved by many mills. The most steam used per ton in hydraulic mills was 5 times that of the smallest. There was no indication that high users of steam were engaging in operations requiring steam for purposes other than cooking meats or desolventizing oil and meal. Solvent-extraction mills were the highest users of steam and averaged 1,200 pounds per ton of seed. Screw-press mills averaged 700 pounds per ton, and hydraulic mills 600 pounds.

Small hydraulic and screw-press mills used more steam per ton of seed than the larger ones (fig. 17). This is to be expected since cooker insulation is not the same for all mills, and even with the same amount of insulation, heat loss from the smaller boilers and equipment can be expected to be relatively greater than the loss from the larger boilers. Radiation losses are nearly the same for all mills, showing that the smaller ones have a higher percentage loss in efficiency of heat generation. Big mills can get higher efficiency because they generate more heat and therefore the loss is a smaller percentage. Also, smaller mills generally do not have condensate return systems, which make possible up to 30 percent recovery in steam.

Mills in the Valley area used more steam than those in the other areas. Here, hydraulic mills used about 60 percent more than those in the Southeast. Screw-press mills in the Valley used 25 percent more than those in the Southeast and 40 percent more than those in the Southwest, on the average. In fact, hydraulic mills in the Valley used more steam than screw-press mills in the Southeast. The quality of seed processed may have partially accounted for this, as seed in the Valley was highest in moisture content in the 1954 season--having 10 percent moisture compared with 8.9 percent in the Southeast, and 8.1 percent in the Southwest (table 5).

Figure 17 does not show steam usage in hydraulic mills in the Southwest because most of these mills were operated by steam and the amount used for cooking meats could not be estimated. There was no relationship between the size of solvent mill and the pounds of steam used per ton of seed. Average usage for solvent mills was a little over 1,200 pounds of steam per ton of seed.

Table 36.--Distribution of cottonseed oil mills by amount of steam used per ton of seed crushed, by type of process and area

Steam used per ton of seed crushed	Hydraulic				Screw press				Solvent
	Total	South-east	Valley	South-west	Total	South-east	Valley	South-west	
	Number	Number	Number	Number	Number	Number	Number	Number	Number
Total mills	18	9	8	1	28	5	7	16	8
201 - 300 pounds ...	1	1	---	---	---	---	---	---	---
301 - 400 pounds ...	6	3	2	1	---	---	---	---	---
401 - 500 pounds ...	1	---	1	---	4	1	---	3	---
501 - 600 pounds ...	4	3	1	---	10	2	3	5	---
601 - 700 pounds ...	2	2	---	---	7	1	---	6	---
701 - 800 pounds ...	---	---	---	---	---	---	---	---	---
801 - 900 pounds ...	1	---	1	---	1	---	---	1	1
901 - 1,000 pounds..	2	---	2	---	3	1	2	---	2
1,001 - 1,100 pounds	1	---	1	---	---	---	---	---	1
1,101 - 1,200 pounds	---	---	---	---	1	---	1	---	1
1,201 - 1,300 pounds	---	---	---	---	1	---	---	1	---
1,301 - 1,400 pounds	---	---	---	---	---	---	---	---	---
1,401 - 1,500 pounds	---	---	---	---	1	---	1	---	1
1,501 - 1,600 pounds	---	---	---	---	---	---	---	---	1
1,601 - 1,700 pounds	---	---	---	---	---	---	---	---	1

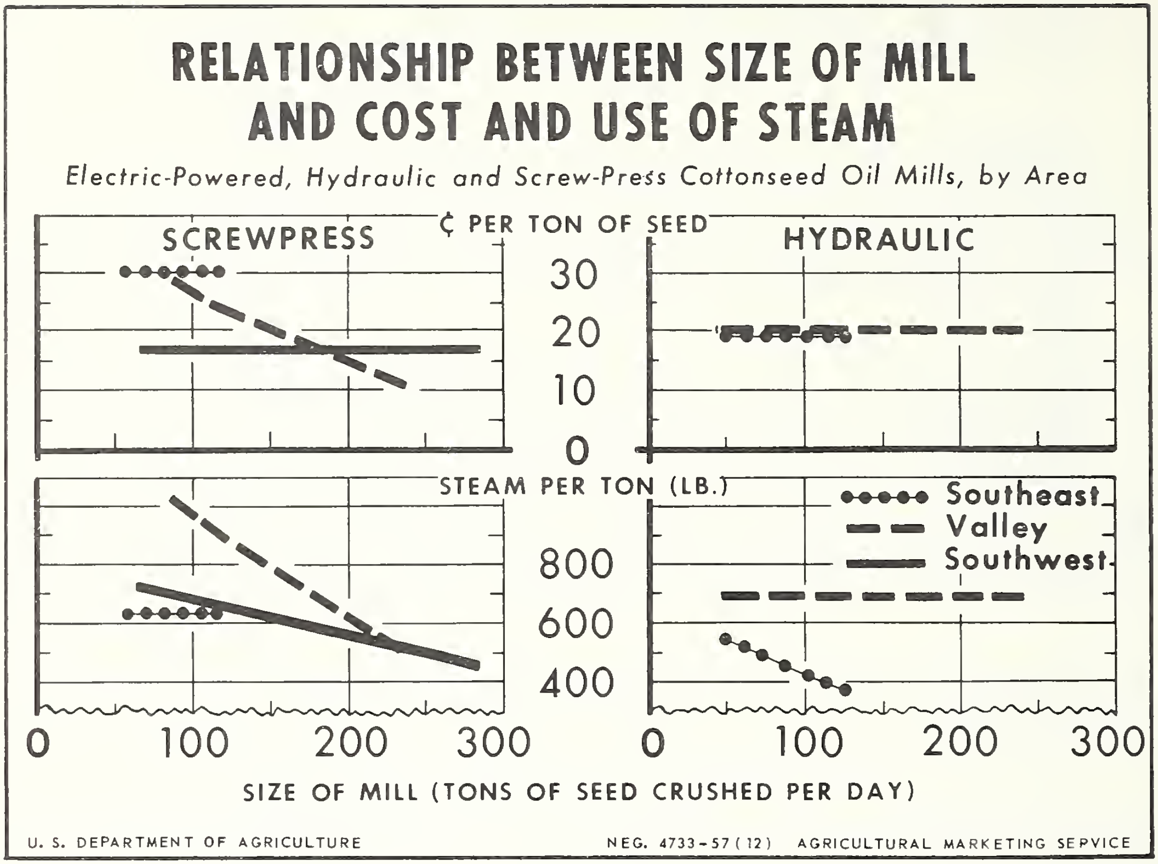

Figure 17

Costs

Costs of each fuel varied widely even in the same area. In the Southeast, where coal was used by about 80 percent of the mills, the cost ranged from $7 to $12 per ton of coal. The average cost of coal for electric-powered mills was $9.25 per ton, compared to $8.27 per ton for steam-powered mills. In Alabama and Georgia the average price of coal was $8.41 per ton, compared to $9.25 in the Carolinas. Fuel oil prices ranged from 6 to 12 cents a gallon, and gas from 32 to 49 cents per thousand cubic feet.

In the Valley area, where about 15 percent of the mills used coal, 9 percent fuel oil, and 75 percent gas, the price of coal ranged from $6.25 to $9 per ton with an average of $6.97. The price of fuel oil ranged from 7 to 12 cents a gallon, and gas from 12 to 45 cents per thousand cubic feet.

In the Southwest area, gas was used by all mills except one. The price ranged from 18 to 45 cents per thousand cubic feet for electric-powered mills and from 7 to 36 cents for steam-powered mills.

Costs of fuels are given on a comparable basis in table 37, which shows the costs per million B. t. u. for electric- and steam-powered mills by areas. The average price per million B. t. u. of fuel was 62 cents for fuel oil, 32 cents for coal, and 23 cents for gas.

Because of the differences in costs of fuel, relationships between size of mill and cost of fuel per ton of seed differ somewhat from relationships between size of mill and amount of steam used (fig. 17). For example, while screw-press mills in the Southeast used, on the average, the lowest amounts of steam per ton of seed, they also paid the highest fuel costs. They also averaged the highest fuel cost per ton of seed. In the Southwest large screw-press mills, because they were located in areas with high fuel costs, lost their advantage of lower steam usage over smaller mills. Their average fuel cost per ton of seed was about the same as for smaller mills. Some high users of steam had as low or lower fuel costs per ton, by paying less for fuel, than more efficient users.

Combined Costs for Electric- and Steam-Powered Mills

Mills that used fuel for producing power, for the most part, were unable to give a breakdown of the fuel required to run the mill and that required for cooking meats and like purposes. Therefore, their power and fuel costs were combined so that they could be compared with electric-powered mills of the same type. The Southwest was the only area having enough mills using both kinds of power. The comparison for screw-press mills is shown in figure 18. The combined electric power and fuel costs for the steam-powered mills was lower than those for the electric-powered mills. Steam-powered mills paid lower prices for fuel, but higher prices for electricity than the wholly electrified mills because of the small amounts of electricity purchased (fig. 19). However, even though these steam-powered mills paid less than the electrified mills for power and fuel combined, part of this gain was offset by higher labor costs, particularly in the boilerroom.

Costs of Related Items and Loss of Solvent

Maintenance and repair cost per ton of seed, based on 1953-54 crushes, was highest for the screw-press mills, as shown in table 38. Screw-press mills that were converted from hydraulic mills in the 1953-54 season are excluded. Hydraulic mills averaged $1.38 per ton, compared with $1.43 for screw-press mills, and $1.19 for the solvent-extraction type. Prepress-solvent mills averaged about one-third higher maintenance and repair costs per ton than direct-solvent mills.

Most mills were unable to report fully on cost of supplies per ton of seed. However, hydraulic mills reported an average of 20 cents per ton of seed for press cloth--25 cents in the Valley, 18 cents in the Southeast, and 12 cents in the Southwest.

Table 37.--Costs paid by cottonseed oil mills for different fuels, per million British thermal units, by area and type of mill power

Area and type of power	Coal				Oil				Gas			
	Mills reporting	Cost per mil. B.t.u.: Average	High	Low	Mills reporting	Cost per mil. B.t.u.: Average	High	Low	Mills reporting	Cost per mil. B.t.u.: Average	High	Low
	Number	Cents	Cents	Cents	Number	Cents	Cents	Cents	Number	Cents	Cents	Cents
Southeast	24	33	44	26	6	58	78	38	1	49	---	---
Electric	18	34	44	28	6	58	78	38	0	---	---	---
Steam	6	31	34	26	0	0	0	0	1	49	---	---
Valley	5	26	33	23	3	69	80	49	21	23	45	12
Electric	5	26	33	23	2	64	80	49	15	24	45	12
Steam	0	---	---	---	1	77	---	---	6	21	30	15
Southwest	0	---	---	---	0	---	---	---	34	23	45	7
Electric	0	---	---	---	0	---	---	---	20	25	45	18
Steam	0	---	---	---	0	---	---	---	14	21	39	7

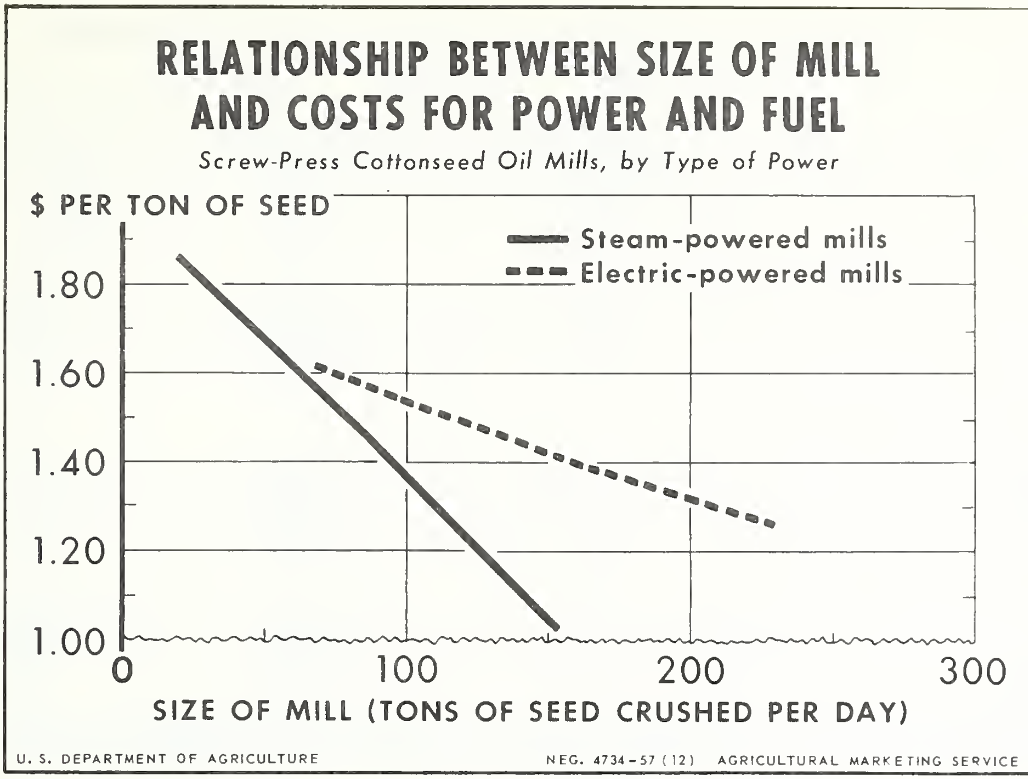

Figure 18

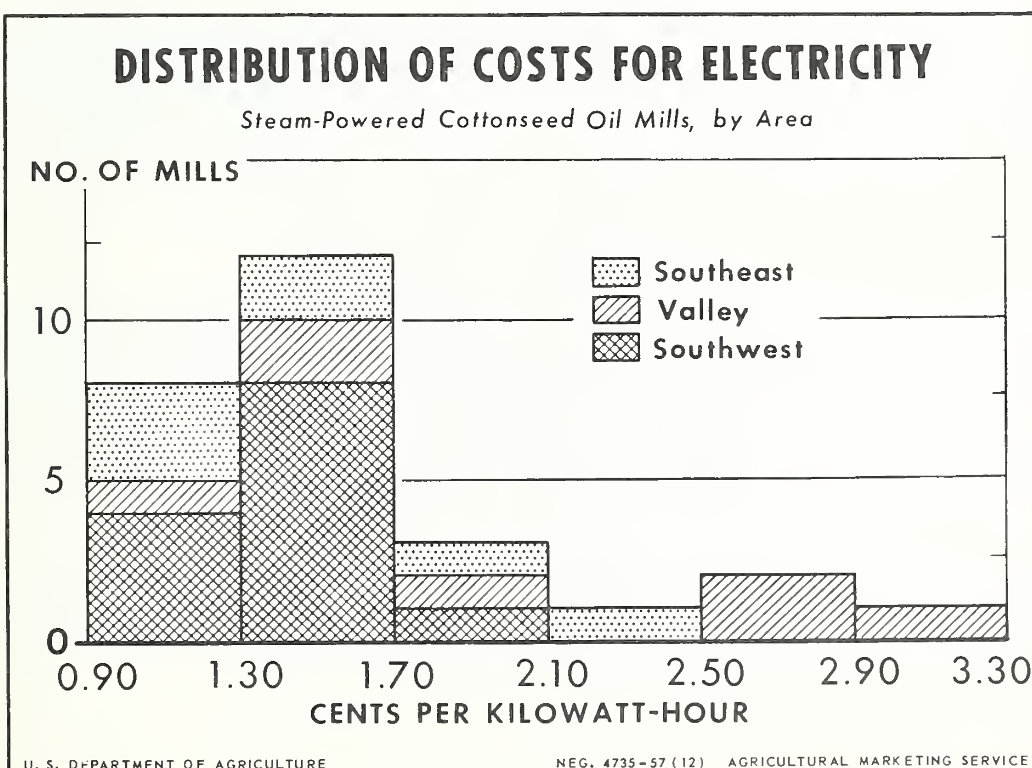

Figure 19

Table 38.--Maintenance and repair cost per ton of seed in cottonseed oil mills, by type of process and area, 1953-54

Type of mill and area	Mills reporting 1/	Seed crushed per mill	Cost per ton per mill
	Number	Tons	Dollars
Hydraulic	39	16,400	1.38
Southeast	19	10,300	1.39
Valley	15	21,100	1.58
Southwest	5	25,200	.75
Screw-press	47	27,700	1.43
Southeast	8	10,000	1.57
Valley	10	27,400	1.64
Southwest	29	32,700	1.32
Solvent-extraction	11	56,900	1.19
Valley 2/	8	53,900	1.06
Southwest	3	65,000	1.52

1/ Excludes mills that changed type of oil-extraction process in 1954.
2/ Includes 2 mills in the Southeast.

Solvent loss in the solvent-extraction mills averaged 2.6 gallons per ton of seed. Mills located in the Southeast and Valley, combined, averaged 2.0 gallons per ton, compared with 4.2 in the Southwest. Prepress-solvent mills used almost 30 percent more solvent per ton of seed than the direct-solvent mills--3.1 compared with 2.4.

OIL-EXTRACTION EFFICIENCY

Efficiency in extracting oil is measured in this report by the residual oil in meal and is based on oil yields in the 1953-54 seasons (table 39). Residual oil in meal, rather than the percentage of oil extracted, is used to measure oil-extraction efficiency, because mills having different meal yields could extract the same percentage of oil, but one mill might leave a higher percentage of oil in the meal. Hydraulic mills averaged 5.2 percent residual oil, screw-press mills 4.2 percent, and solvent mills 1.1 percent.

There was a wide range in extraction efficiencies among mills of the same type. As shown in figure 20, the range was widest for screw-press mills, which had from 1.6 to 6.9 percent residual oil, compared with 0.6 to 2.7 percent for the solvent mills.

Table 39.--Estimated residual oil in cottonseed oil meal, by type of mill and area, 1953-54

Type of mill and area	Mills reporting	Oil in seed		Oil extracted per ton of seed		Meal yield per ton of seed	Oil left in meal 2/	
		Percentage 1/	Quantity per ton	Quantity	Percentage of total oil in seed		Quantity per ton	Percentage
	Number	Percent	Pounds	Pounds	Percent	Pounds	Pounds	Percent
Hydraulic	32	18.20	364	309	84.9	979	51	5.2
Southeast	14	18.39	368	310	84.2	987	54	5.5
Valley	12	18.56	371	321	86.5	960	46	4.8
Southwest	6	17.03	341	284	83.3	999	53	5.3
Screw press	45	18.34	367	322	87.7	956	40	4.2
Southeast	9	17.77	355	306	86.2	973	46	4.7
Valley	11	18.76	375	330	88.0	936	41	4.4
Southwest	25	18.36	367	325	88.6	958	38	4.0
Solvent-extraction ..	12	18.75	375	361	96.4	944	10	1.1
Direct-solvent	6	18.90	378	362	95.9	932	12	1.3
Prepress-solvent ..	6	18.60	372	360	96.8	956	9	.9

1/ Based on quality of seed.
2/ Assuming 4 pounds of oil left in hulls and linters.

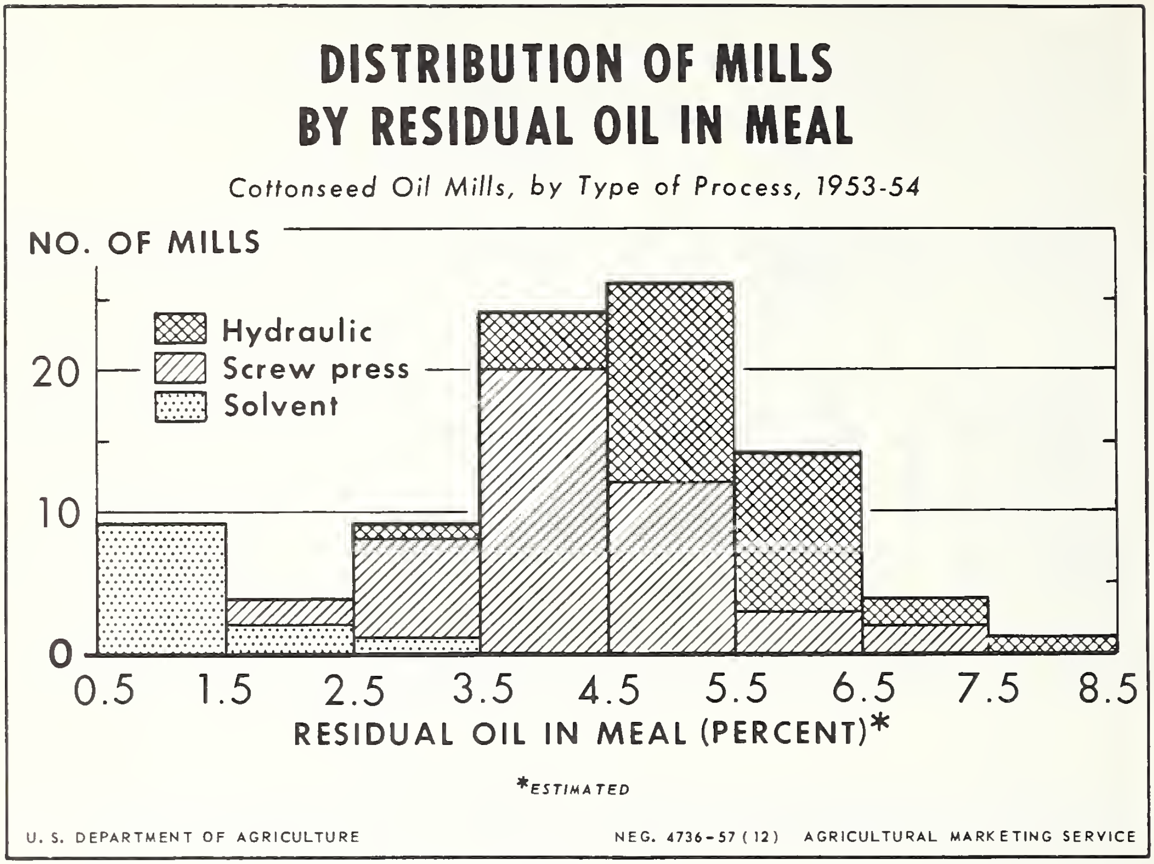

Figure 20

DIFFERENCES IN COSTS OF LABOR AND OTHER ITEMS RELATED TO OIL-EXTRACTION EFFICIENCY

Differences in costs of labor, electric power, fuel, and maintenance and repair, together with differences in efficiency in extracting oil, may be used to a limited extent in comparing performances of mills. The average costs per ton of seed for the specific services mentioned previously totaled $7.02 for hydraulic mills, $6.08 for screw-press, and $5.46 for solvent-extraction mills. Residual oil in meal per ton of seed averaged 51 pounds for hydraulic mills, 40 for screw-press, and 10 for solvent mills. These amounts are equivalent, respectively, to $6.63, $5.20, and $1.30 per ton of seed for value of oil left in meal if cottonseed oil sells at 13 cents a pound. In terms of these specific costs, and losses of oil revenue, solvent-extraction mills are in a much better economic position than the other types, as shown below:

Advantage of--	Cost	Oil returns	Net gain
	Dollars 1/	Dollars 1/	Dollars 1/
Solvent-extraction over hydraulic	-1.56	+5.33	6.89
Solvent-extraction over screw-press ..	-.62	+3.90	4.52
Screw-press over hydraulic	-.94	+1.43	2.37

1/ Per ton of seed.

However, there was a wide range among mills in the costs of labor and power and fuel, as shown in table 40. The overlap in these costs among groups shows that the advantage of one type or size of mill over another could also vary. Generally, in mills of similar size and type, those that used the most labor per ton also used the most power. Conversely, mills using the least labor also used the least power. However, in terms of costs, some mills reversed their relative positions because they paid higher or lower rates for labor and power than other mills. The cost of labor for all mills ranged from $1.29 to $8.14 per ton of seed, a difference of almost $7, whereas costs of electric power and fuel ranged from $0.82 to $2.95, a difference of $2.13 per ton (table 40). The difference among mills in labor cost, being more than three times the difference in power and fuel costs, indicates that improvement in labor usage is more important than improvement in power usage. Residual oil in meal per ton of seed ranged from 5 to 24 pounds for solvent mills, from 14 to 63 pounds for screw-press mills, and from 33 to 73 pounds for hydraulic mills. Thus, even in oil-extraction efficiencies there was some overlap among mills of different types.

The wide variation in the use of labor, power, fuel, and related items by these sample cottonseed oil mills indicates that substantial improvements can be made in the operation of most mills. It is obvious that more efficient modern equipment would benefit many mills, also that large mill equipment of any type normally operates with greater economy under optimum conditions than smaller units do. Nevertheless, in most mills the many minor conditions that in total frequently make the difference between profit and loss can be significantly improved. The fact that generally mills that were the most efficient in use of labor were also the most efficient in use of power indicates that management is the key factor in holding down costs of a mill; and that management is more important than a mere increase in size or a change in type of mill. If a mill is persistently using more labor or power in one or more departments than the average for similar mills, special attention should be given to the operations of those departments.

Table 40.--Differences in costs of labor and electric power and fuel, by type and size of cottonseed oil mill, and area

Item	Labor cost per ton of seed 1/				Electric power and fuel costs per ton of seed			
	Mills reporting	Average	Low-high	Range	Mills reporting	Average	Low-high	Range
	Number	Dollars	Dollars	Dollars	Number	Dollars	Dollars	Dollars
All mills	104	3.39	1.29-8.14	6.85	73	1.54	0.82-2.95	2.13
Type of process:								
Hydraulic	35	4.16	2.12-8.14	6.02	29	1.48	1.01-2.47	1.46
Screw-press	58	3.04	1.29-7.11	5.82	33	1.61	.94-2.95	2.01
Solvent-extraction	11	2.80	1.75-3.68	1.93	11	1.47	.82-2.25	1.43
Size of mill:								
100 tons and under	48	3.85	1.60-8.14	6.54	31	1.69	.94-2.95	2.01
101 - 200	44	2.99	1.29-5.30	4.01	33	1.51	1.07-2.25	1.18
201 and over	12	3.02	2.11-4.59	2.48	9	1.12	.82-1.48	.66
Area:								
Southeast	29	3.90	1.43-6.30	4.87	19	1.85	1.26-2.95	1.69
Valley	33	3.39	1.75-8.14	6.39	26	1.41	.82-2.25	1.43
Southwest	42	3.04	1.29-7.11	5.82	28	1.45	.94-2.18	1.24

1/ Used on a typical operating day.

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